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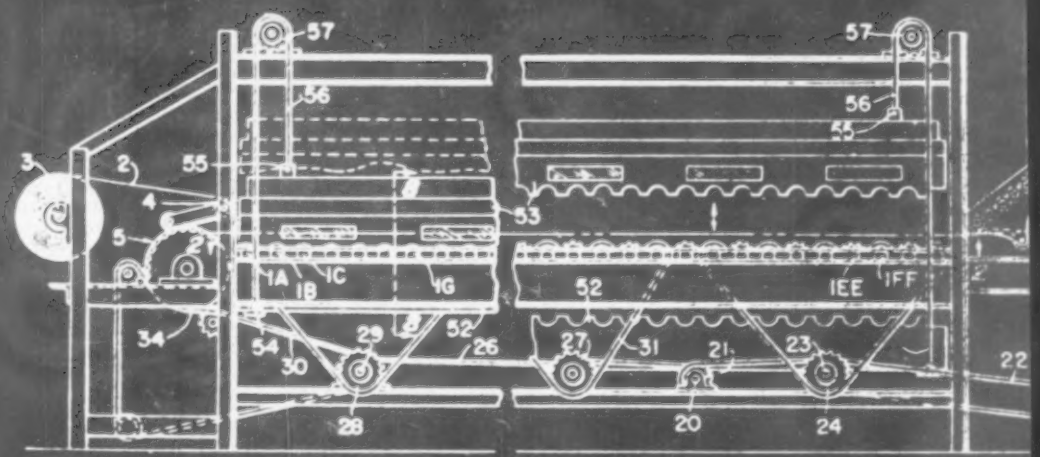
THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY



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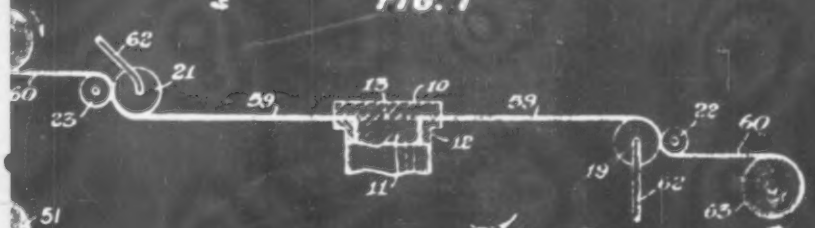

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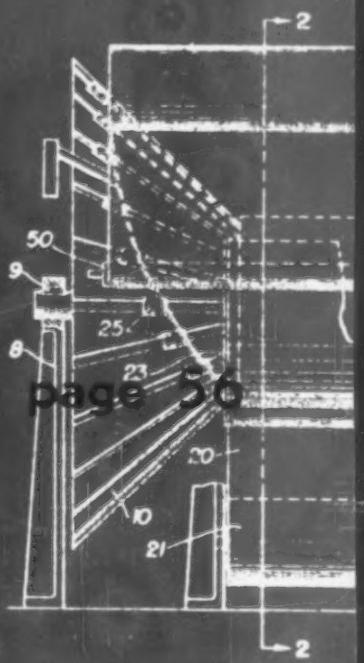

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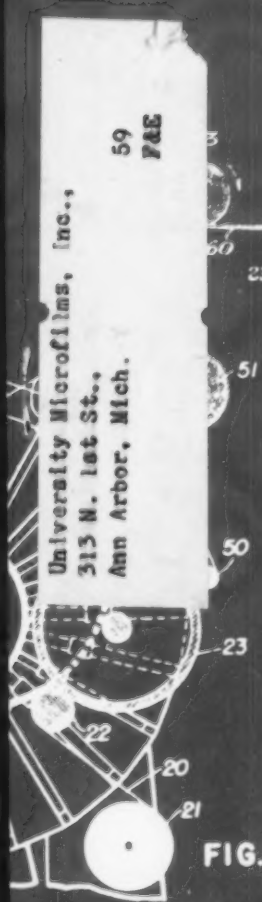

FIG. 2

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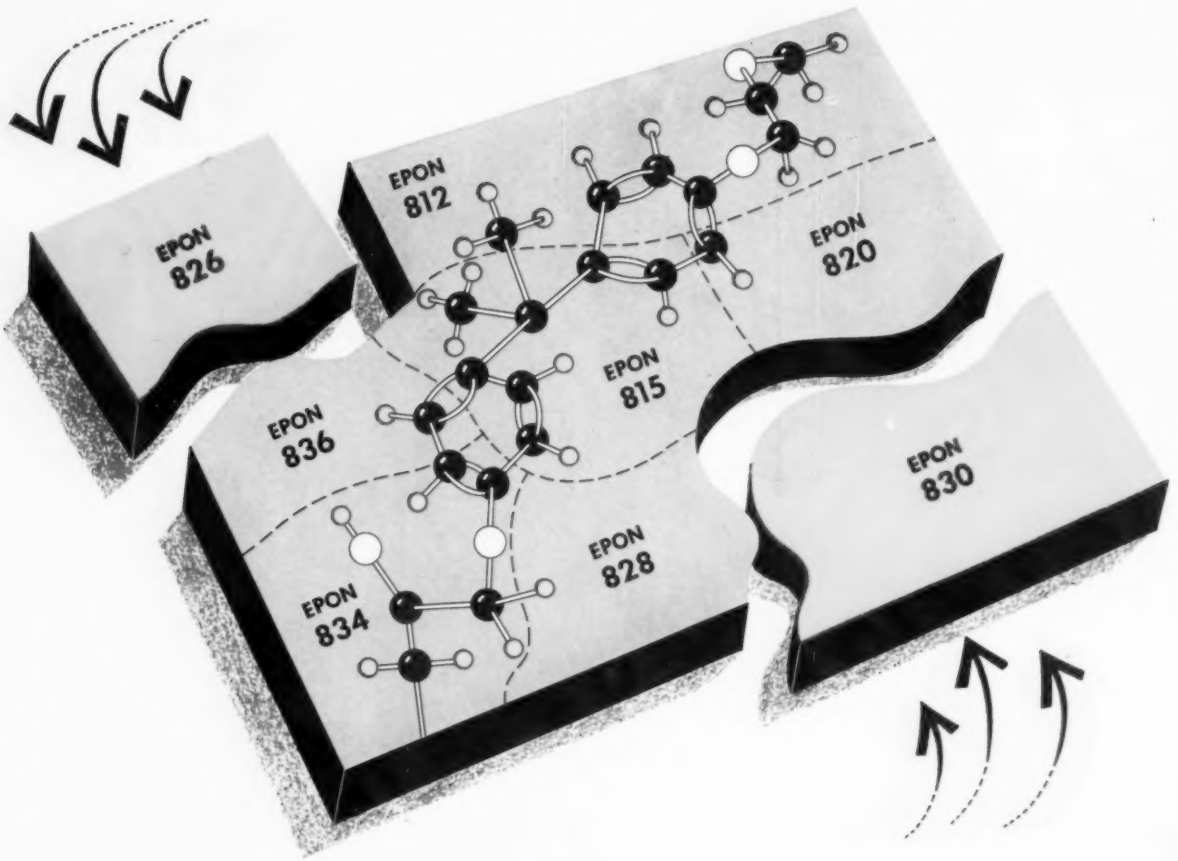

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THE MAGAZINE OF APPLIED ENGINEERING

November 1960, Vol. 6, No. 11

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control of variables in heat resistant glass reinforced plastics ..... p. 39

by RALPH H. SONNEBORN, ALLAN B. ISHAM, FRANK W. DENNEN

This paper summarizes the importance and effect of variables in materials and processing techniques for structural fibrous glass-reinforced plastic panels.

hows and whys of plastic tooling ..... p. 48

by F. L. BOGART

For dimensional control of plastics tooling resins, it is necessary to know the effect of fillers and reinforcing materials on cure cycles and understand the effect of adverse conditions on the setting cycle. When shrinkage is controlled within allowable limits and post-shrink is considered and allowed for, high accuracy is possible.

economics and limitations of blow molding ..... p. 52

by VERNON HILL

Limitations of blow molding are set by the time required for cooling the material in the mold, the size and weight of the part, and the length of run that can be obtained.

guest editorial:

polyolefins—recent developments of italian chemical industry ..... p. 50

by DR. PIERO GIUSTINIANI

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PARAPLEX G-60 and G-62 have been widely used in vinyl film for packaging for nearly five years, and were originally accepted by the Food and Drug Administration and the Meat Inspection Branch, Department of Agriculture for food packaging on the basis of a two-year series of extensive feeding tests conducted at the Medical College of Virginia.

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Letters to the Editor

Apologia sua vita

Dear Sirs:

I believe that Allan L. Griff's letter about my Guest Editorial "Industrial Publicity—Just the Facts" was prompted by a stab of conscience. That I can understand because most engineers (by their own admission) don't write very well.

"Preconceived notions and prejudices . . . " Ask a representative sampling of engineers if they like to write and are able to write. You will learn that almost all of them dread the chore. We industrial publicists deal with technical facts, but we are trained to present them so that a reader is not lost after one glance.

"Free publicity . . ." The guest editorial was written to fill a need for pertinent information about a little-understood activity. The editorial has been reprinted by several advertising and public relations firms who regard it as an important message.

"A large proportion of PLASTICS TECHNOLOGY readers are (Sic) technical." True enough, but for your further information, Mr. Griff, this highly regarded magazine also is read by company presidents, vice presidents, comptrollers, purchasing agents and those in advertising, sales, marketing and public relations. It is read also by plant superintendents and machine operators. My goal was to educate, not to vilify. It was written to be understood easily by all.

"A trade whose language you don't understand . . . " I venture to say that any competent industrial writer is capable of producing a fine article on any particular subject. This talent is what differentiates the technician from the writer. I have written and placed articles on the following subjects: klystrons, synchro-cyclotrons, nuclear radiation, jet engine thrust reversers, aircraft tooling, missile ablative components, telemetry antennas, explosive forming, radomes, and a hundred others. In most cases, the information was obtained on one day and the article written on another.

"Please fit the publicity to the readers . . ." Great. That is why technologists write only for other technologists. We have no argument with this. But is there any reason why technologists cannot simplify their language? And contrary to the thought presented in the letter, a highly technical subject can be treated in an article for complete understanding by "housewives, musicians, stenographers and lawyers."

"These are the people we live and work with . . ." How true. In my travels about the country, I interview engineers, chemists, scientists and others for information to be used in industrial publicity articles. Inevitably I am asked, "What can we do to enliven our technical papers, reports and talks?

Forget about the theorems, formulae, graphs, charts and other inhibitions. Just talk it out and stop when enough has been said.

If Mr. Griff writes all of his technical articles with the clarity equal to his August letter, we heartily recommend that Du Pont set him up as an editor to screen all technical material.

Scott J. Saunders
Scott J. Saunders Associates
San Carlos, Calif.

(In the heat of battle "Just the Facts" author Scott Saunders overlooks one important fact in his last paragraph—Mr. Griff's affiliation is with Union Carbide, not Du Pont. Seriously, there is considerable merit to both gentlemen's statements. I disagree heartily with Mr. Saunders when he wants to eliminate graphs and tabular data. While it is possible to present an article on plastics processing which could be understood by housewives, musicians, etc., we have no desire to do so. None of these good people are among our readers. Mr. Saunders is quite right, however, in asserting that many technical men needlessly complicate their sentences with polysyllabic words. Readers are not interested in an author's vocabulary. No one, whether a high school grad or a PhD, wants to call on every last bit of his education just to read a four-page article. I have reread hundreds of sentences trying to figure out just what the writer was saying—and it was not the technical terms which threw me. Truce, anyone?—Editor)

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

What to look for in December

Markets for Flexible Foams. P. B. Nortman, Market Consultant, Leonia, N. J.

Current and potential markets for urethane, vinyl, and latex rubber foams are described and compared, with particular emphasis on the urethanes. The development and structure of the foam industry is given, along with comparative costs. Market fields covered include furniture, automotive, packaging, clothing, rug underlays, toys and novelties, footwear, construction, and industrial.

•

Technical Aspects of Molding Acrylics. J. F. Moore, Technical Rep., Rohm & Haas Co., Philadelphia, Pa. This is a two-part article to be run in December and January. Injection molding of acrylics (standard and modified) generally falls into four categories: basic materials and their characteristics; gate, runner, and mold design requirements; techniques for molding the part; and tests for quality. A wide range of molding conditions is possible with the acrylics.

•

Surface Quality of Fiberglass-Reinforced Polyester Moldings. W. J. Diamond, Sr. Chemical Engr., The Brunswick-Balke-Collender Co., Muskegon, Mich.

The growth of the glass-reinforced plastics field in many product lines has been retarded by limitations of surface quality caused by entrapped air and inadequate resin-glass bond. Test results given are based on microscopic studies of specimens both before and after stressing. Two types of stress were used; a slow bending creep, and a fast Izod-type impact.

•

Economies Through Bulk Shipment of Plastics. D. B. Semeyn, Customer Service Engr., Plastics Technical Service, The Dow Chemical Co., Midland, Mich.

Shipment of resins in "carload" quantities provide savings to the fabricator in terms of efficiency and economy. The molder can benefit in raw material cost, warehouse space, materials-handling labor, spillage, and rejects caused by contamination of the materials.

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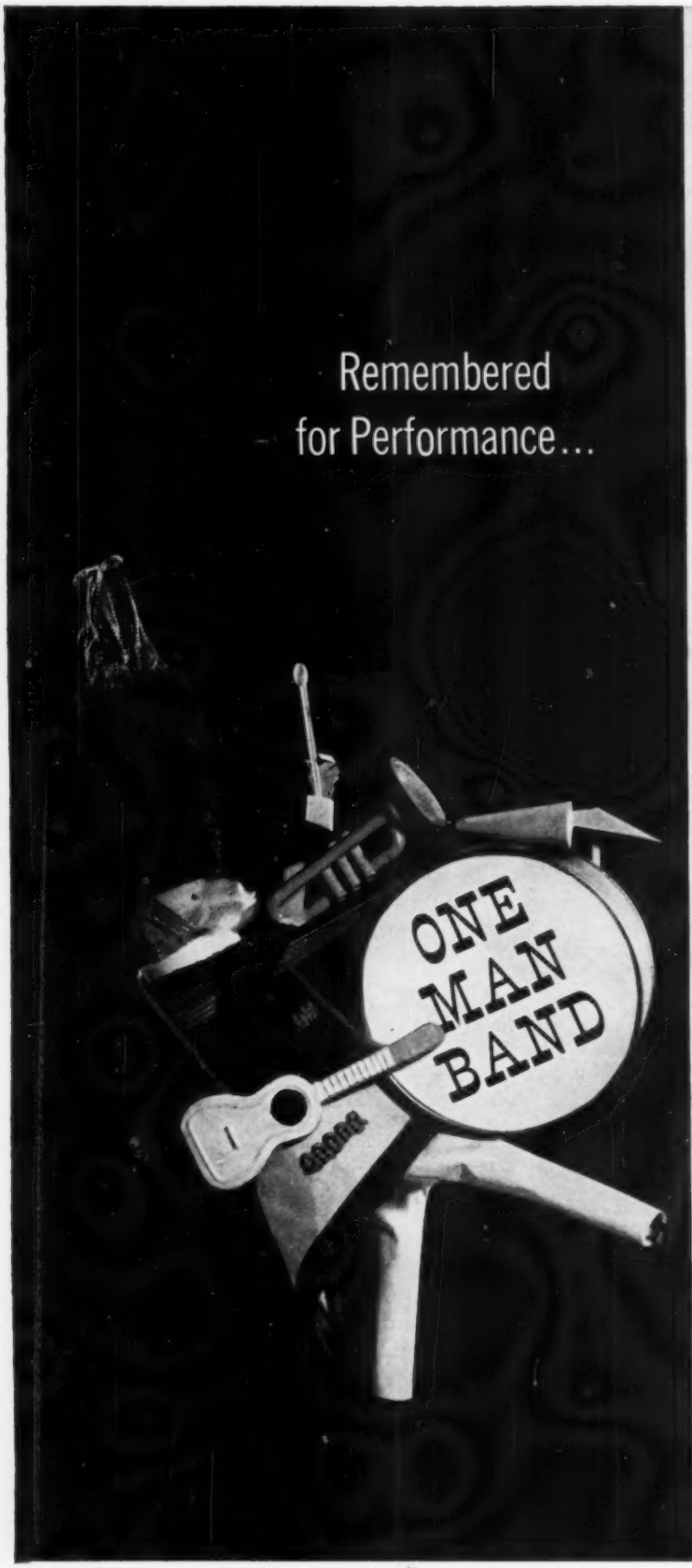

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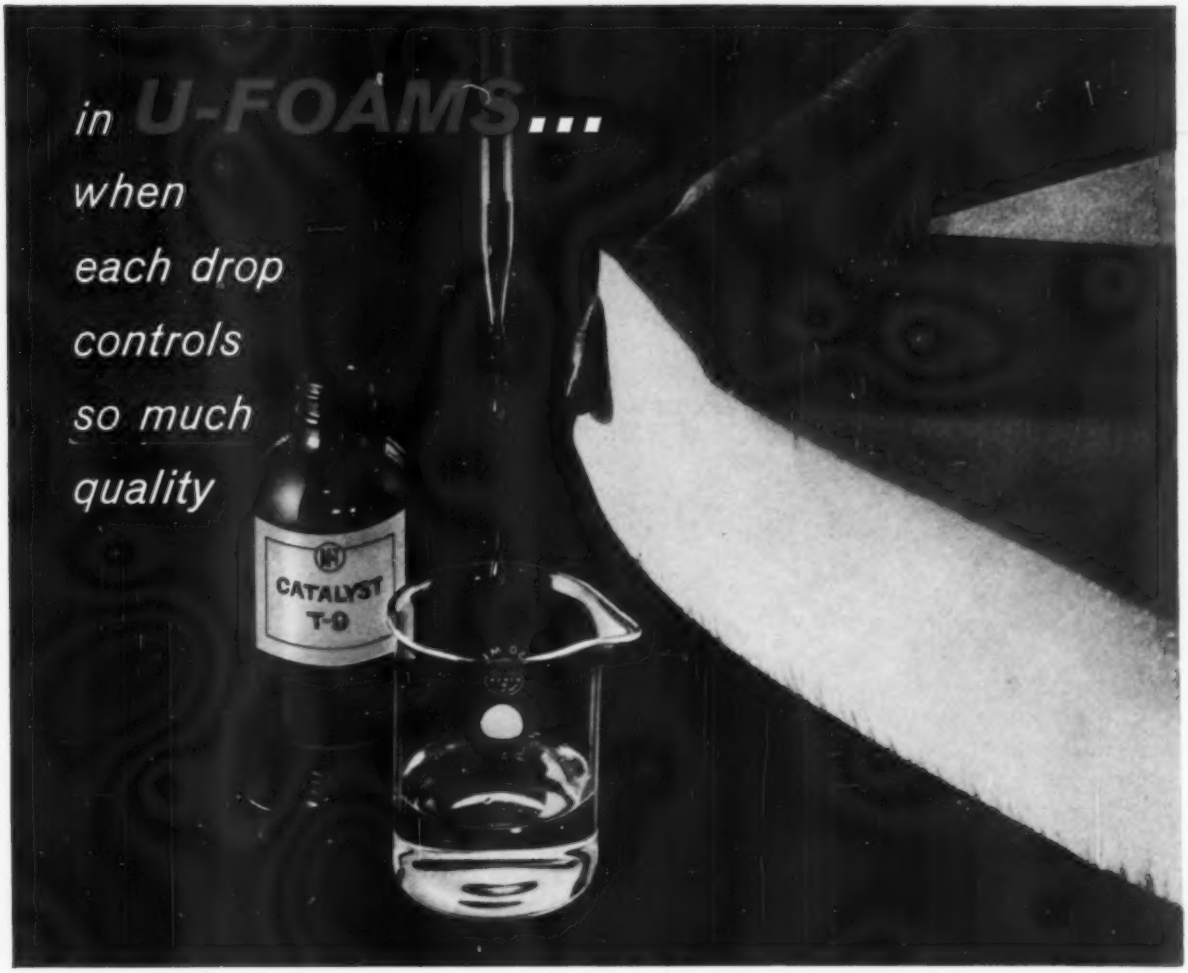

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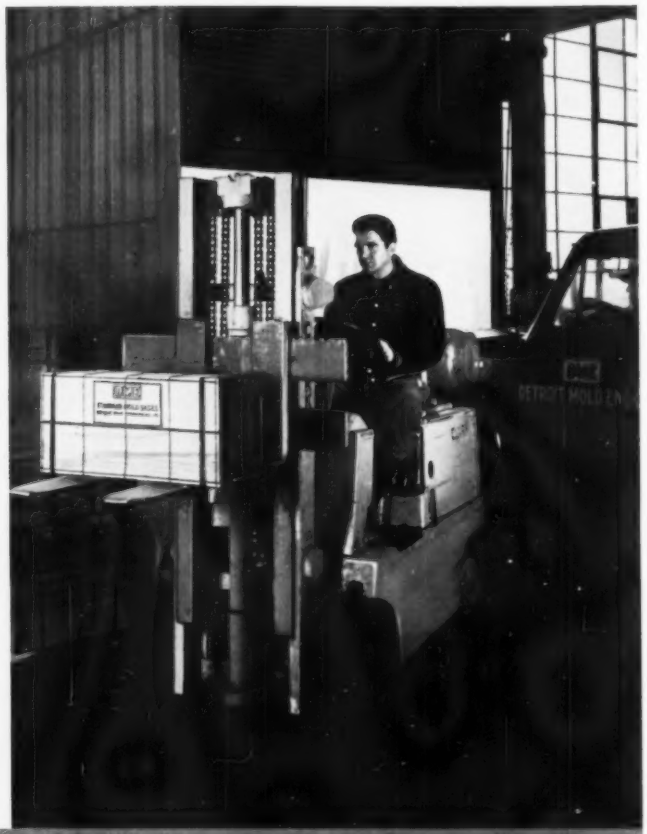

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"... Emery plasticizers in our Federan give us excellent results at economical prices."

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"...extra performance becomes one of the primary considerations in evaluating the cost of a plasticizer."

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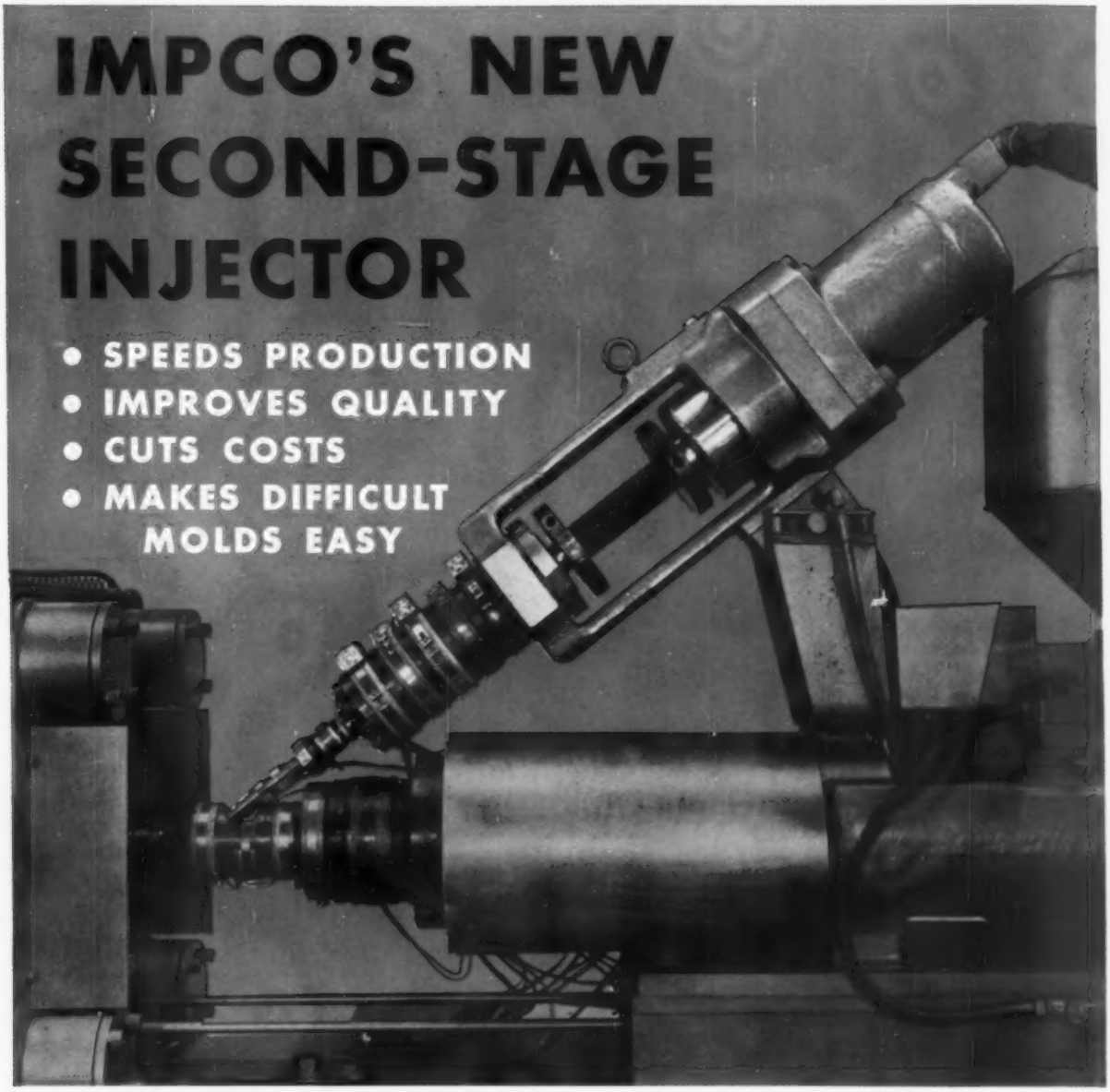
IMPCO'S NEW SECOND-STAGE INJECTOR



- SPEEDS PRODUCTION
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MANUFACTURERS OF IMPCO PLASTIC MOLDING MACHINES

NOW AVAILABLE FROM NEW PLANT...

SANTICIZER® 409

ASSURED SUPPLY

Monsanto's new multimillion-lb./year plant producing SANTICIZER 409 is now onstream at Everett, Mass. Production was multiplied greatly in response to rapid acceptance of this versatile plasticizer by the plastics industry.

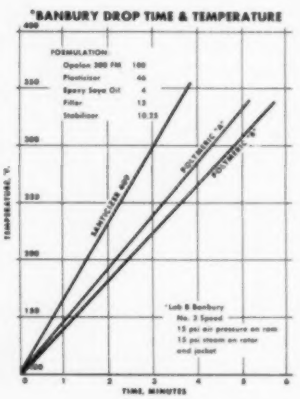
IMPROVED PERMANENCE

SANTICIZER 409 is highly compatible and imparts good performance properties to vinyls. Volatility is low. Heat stability and light stability are excellent. Comparative tests show that SANTICIZER 409 resists solvent extraction best of all lower-cost polymeric plasticizers. SANTICIZER 409 *stays put*, won't exude even in high humidity.

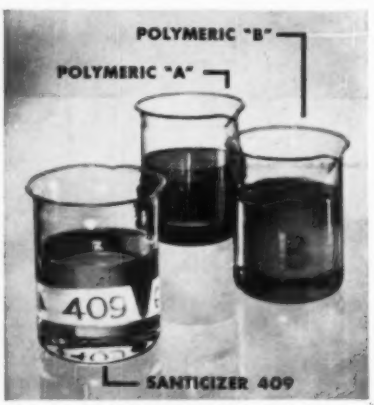
FASTER PROCESSING

SANTICIZER 409 has low viscosity, high solvency . . . for much faster fusion and extrusion. Helps prevent pinholes, "fisheyes," and roughness. You can count on SANTICIZER 409 to boost output, reduce processing problems, and assure optimum physical properties *within your processing-temperature range.*

FAST FUSION



OPTIMUM CLARITY



HIGH PURITY

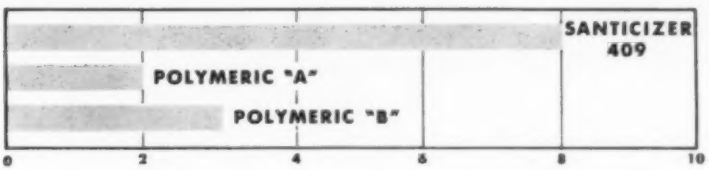
SANTICIZER 409 is clear, non-hazy, light-colored. Contains no flocculent matter that might weaken electrical properties or cause spotting in thin films and transparent sheeting. SANTICIZER 409 adds no odor to gaskets or wire insulation for refrigerators or other low-odor applications.

SUBSTANTIAL SAVINGS

Compare prices and specific gravities. SANTICIZER 409 gives compounders more plasticizer per dollar . . . *more profit per unit volume of compound.* And easier, quicker processing provides added savings.

WEEKS TO EXUDE AT 100% HUMIDITY, 60°C

HIGHER COMPATIBILITY



FOR BETTER INSULATION

Specify SANTICIZER 409 to simplify processing and assure superior electrical properties . . . especially for 105° C. appliance wiring, plastisols, and adhesive-backed insulating tapes. Vinyls compounded with SANTICIZER 409 show consistently high resistivity . . . *plus* excellent compatibility even in high humidity, superior retention of properties after heat aging, and no corrosion of copper.

FOR BETTER SHEETING, FILM, AND COATINGS

You can easily meet tough specifications with SANTICIZER 409 . . . for such products as automobile upholstery, adhesive-backed decorative film, unsupported sheeting, scuff- and extraction-resistant film, and corrosive-resistant protective coatings. SANTICIZER 409 improves processing properties. It's practically odorless. It doesn't migrate, imparts better low-temperature flexibility than many other polymeric plasticizers, and offers superior resistance to extraction.

compare benefits with any other polymeric plasticizer

SANTICIZER 409 GIVES BETTER VINYL COMPOUNDS AT LOWEST COST

Monsanto®

Monsanto, maker of more plasticizers than any other company, provides these benefits to customers:

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Organic Chemicals Division
St. Louis 66, Missouri

Please send me: ☐ Technical Bulletin PL-409 ☐ Test sample of Santicizer 409

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This Month in Brief

This month's first article, "Control of Variables in Heat-Resistant Reinforced Plastics," tells just how these variables affect processing techniques. The variables in question are component materials, the effects of layup procedures, evaluation of panel properties, and part inspection.

"Hows and Whys of Plastic Tooling" explains the proper use of fillers, pointing out how they assure the production of consistent, large epoxy tools within predictable tolerances.

"Economics and Limitations of Blow Molding" are not determined by the number of molds employed, but by the length of the production run for a single item. Two tables compare the costs involved.

Reinforced plastic boat manufacturers are warned against taking-on unqualified dealers in their rush to get boats on the market - see this month's engineering forum. Harry Douglas feels that chain stores make the best outlets, unless some type of arrangement can be worked out with an existing boat dealer. Service stations are out!

The guest editorial in this issue is by the managing director of Montecatini, Dr. Piero Guistiniani. In addition to describing his firm's role in polyolefin development, he outlines the patent structure as it affects a foreign firm in the American market.

Our editorial describes certain results of a recent survey on the likes and dislikes of American housewives in food packaging. Our point is this - plastics are enjoying a wide acceptance, but it could be greater. Don't be satisfied with less than complete domination of any market. Any percentage can be raised if one knows his market, selects his materials on the basis of their properties, and designs within established limitations.

Exploring Fabrication Techniques is concerned this month with biaxially-oriented film and sheet. The modifications required of existing equipment are described in some detail.

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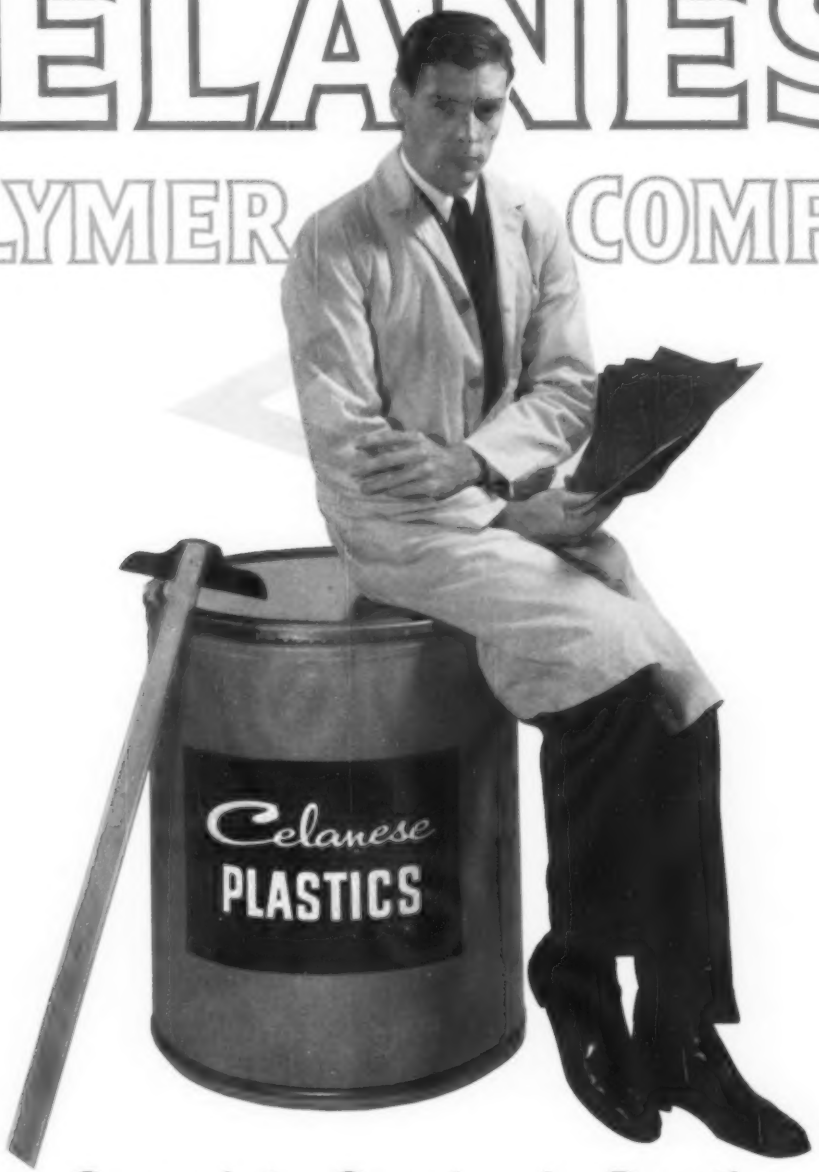

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CELLULOSE PROPIONATE

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Acetate, Propionate and Triacetate
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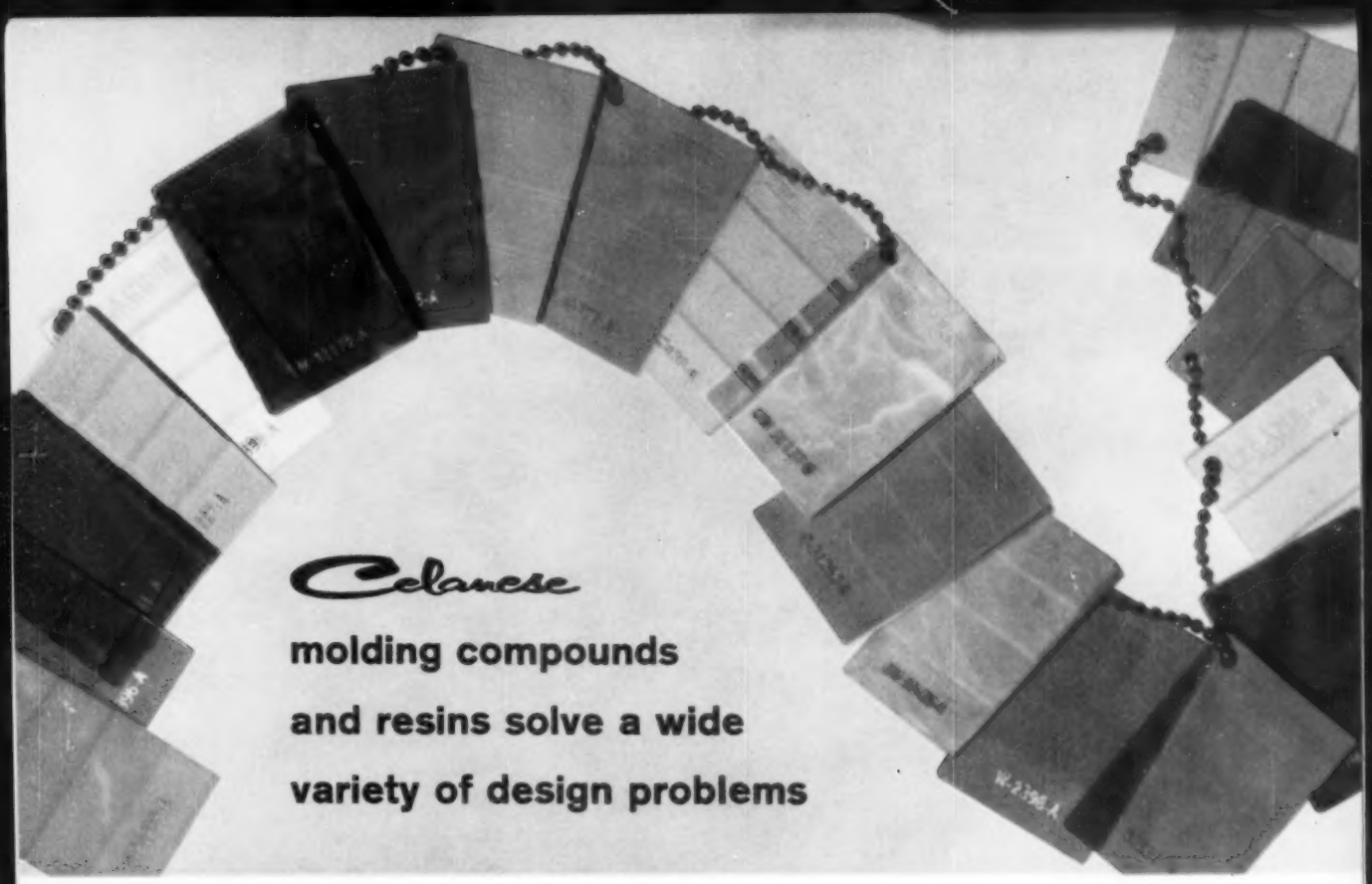

Celanese molding compounds and resins solve a wide variety of design problems

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Outstanding among thermoplastics for its excellent balance of properties, Forticel meets the demands of a number of automotive and appliance applications. Forticel has excellent dimensional stability, toughness, surface permanence and moldability, and is free of objectionable odor. Applications: automotive steering wheels and decorative trim, appliance and telephone housings, brush backs, dials, knobs and blow molded products.

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Rugged, versatile, economical, Celanese Acetate is unequalled for its combination of toughness, clarity and price. It is available in a wide range of formulations and flows—in a limitless variety of scientifically matched colors. Applications: shoe heels, appliance housings, jewelry, tool handles, toys, sun glass frames, brush backs, houseware items and blow molded products.

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Here are the properties that speed production, cut down rejects. Celanese Polyester Resins offer fast cure, low drainage, better wet-out in hand lay-up. They are unequalled for saving time and labor on critical large area moldings. And they are outstanding for formulating and molding pre-mix and matched die parts. Applications: Boats, refrigerator doors, truck bodies, cooling tower grids, automotive and appliance parts, electronic housings, and decorative items.

CELLULOSIC FLAKES

Celanese offers cellulose acetate, cellulose triacetate and cellulose propionate flake in a variety of grades to basic industries such as plastics, sheet, film, fibers, protective coatings and adhesives. Specific applications include lacquer for paper, wire, and flashbulb coatings; film and sheeting for photography, graphic arts, and transparent packaging; molding powder for extrusion and injection molding of tool handles, tubing, and toys; and binders for color concentrates.

CELANESE TECHNICAL SERVICE

Celanese has the engineering staff to help you get the most out of plastic materials at any stage from design to finished product. This service includes: design consultation, assistance with mold design, material selection, equipment and its adaptation, pilot molding supervision and product testing.

The Celanese Technical Service Laboratory is one of the finest of its type. It is complete with actual production equipment, color matching departments, and analytical and physical testing laboratories. For the right answers to problems of plastic application, or technical information on specific plastic materials, write: Celanese Polymer Company, Dept. GK-11, 744 Broad Street, Newark 2, New Jersey.

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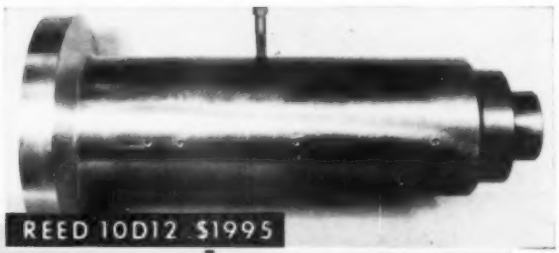

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What's new in processing

B.I.P. Engineering, Ltd. Streetly Works, Sutton Coldfield, England, has introduced a range of injection units for use with compression presses of suitable locking force. Self-contained, they incorporate a hydraulic fluid reservoir, power unit pump, and controlling valve gear. The units should prove valuable in molding both thermoplastic and thermosetting resins.

First sheet extrusion of Mobay's Merlon polycarbonate on a production basis has been announced by Rowland Products, Kensington, Conn. Sheets measured 22 by 51 inches, and gages range from 20 to 250 mils.

Molded Fiber Glass Sheet Co., Ashtabula, O., has developed a process for forming reinforced plastic panels into extreme and compound curves. Extremely useful for short production runs, the technique obviates the need for expensive molds in short production runs. There is no sacrifice in physical properties. Any wall thickness is possible, and any curvature down to a radius of three inches.

Abstracts

"Production of Glass-Reinforced Polyester Moldings by Fiber/Resin Spraying Method" by A. Wende and G. Plotz, Plaste und Kautschuk, May, 1960, gives measurements for setting up calibration curves.

"Vacuum Deep-Drawing of Polycarbonate Sheet" by W. Neitzert, Plastverarbeiter, June, 1960, describes successful operations on both experimental and industrial scales.

"Vacuum Forming of Biaxially Oriented Polystyrene" by A. Matthews and G. Hulse, British Plastics, October, 1960, discusses both the process and handling differences due to the nature of the product involved.

"How to Make Continuous RP Pipe" by D. Henis, Modern Plastics, Sept., 1960, presents a novel system of collapsing mandrels which permit the production of continuous piping.

"Molding Flexible Polyether Urethane Foams" by Mobay authors (4), SPE Journal, October, 1960, outlines the process for molding thin sections of one-shot polyether foams in thin-gage metal molds. A high-output source of radiant heat is used.

Patents

2,923,978 to Raymond De-Icer & Engineering Co., Los Angeles, Calif.—Vacuum Bag Molding Method.

2,923,979 to E. I. du Pont de Nemours & Co.—Production of Self-Supporting Reticulate Sheet of Chlorosulfonated Polymers of Ethylene.

2,923,975 to Voumard Machines Co., La Chaux-de-Fonds, Switzerland—Method of Molding a Plastic Tube, Device, and Method for Utilizing Device.

2,922,193 to Vincenzo Bonfiglio, Milan, Italy—Process and Machine for Reproducing Lace and Perforated Articles with Plastic Material.

2,922,194 to British Celanese, Ltd.—Process for the Manufacture of Self-Supporting Tubes of Thermoplastic Material.

2,923,035 to Empire Brushes, Inc., Port Chester, N. Y.—Method for Molding Plastic Articles (Metal Inserts).

New member of the Oncor® family–23A...

A unique pigment for flame retardance in halogenated plastics and paints

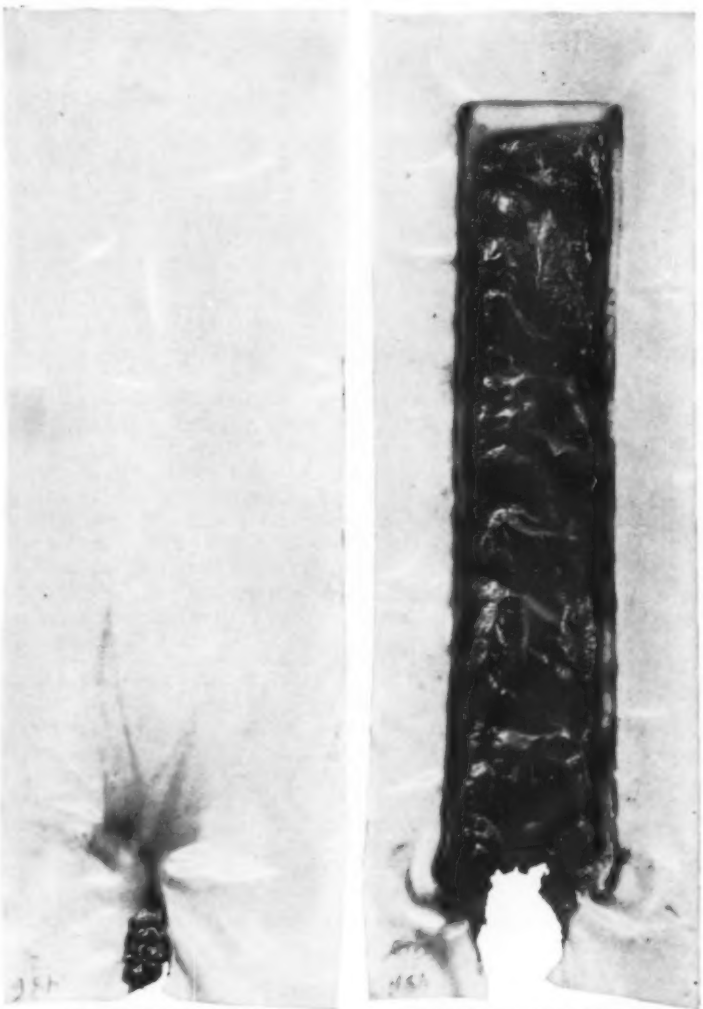
Never before has there been a pigment like ONCOR® 23A, developed especially for compositions based on halogenated resins. This pigment is composed of an inert silica core of low specific gravity, and has a surface layer of antimony oxide fused to the core.

Here's a quick run-down on the outstanding features of this significant new ONCOR pigment:

1. **Effective Flame Retardance** – ONCOR 23A pigment compares favorably with conventional antimony oxides in flameproofing efficiency in halogen-containing resins for plastics and paints. In tests on vinyl films, ONCOR 23A pigment has given equivalent flame resistance compared to conventional antimony oxide, on an equal weight basis.
2. **Low Tinting Strength** – ONCOR 23A pigment has a low and uniform tinting strength. In vinyl film tests, tinting strength consistently measures between 60% and 65% of a conventional antimony oxide standard. This allows most effective use of colorants.
3. **Low Specific Gravity** – Because of its special physical structure, ONCOR 23A pigment has a lower specific gravity than regular antimony oxides. This means a higher volume yield per pound of pigment.
4. **Excellent Dispersion Characteristics**—as a result of careful production controls, ONCOR 23A pigment has a particularly uniform particle. This assures consistently good dispersion in both plastics and paints.

ONCOR 23A pigment is suggested for use in all halogenated plastic and paint compositions requiring flame resistance. It may be used with polyvinyl chloride, vinyl chloride copolymers, chlorinated paraffins, chlorinated rubber, chlorosulfonated polyethylene, chlorinated polyesters and the commercial fluoropolymers.

Additional information on the new ONCOR 23A pigment is provided in the National Lead Company Data Sheet just off the press. The handy coupon at the right will bring you a copy by return mail.



WITH ONCOR 23A **WITHOUT ONCOR 23A**

These two samples show typical flammability test results on vinyl film, following the procedure specified in ASTM D-1433-58. (See Item 1 in text.)

KC-6295

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DOW **Plastiatrics**

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

ACCELERATED AGING TESTS HELP EVALUATE PLASTICS' WEATHERABILITY

The weatherability of plastics materials is most accurately determined by exterior exposure testing. However, accelerated (machine) aging is often valuable for initial screening, and usually a correlation of results between outdoor and indoor testing can be established.

In selecting plastic materials for engineering use, major considerations are maintenance of adequate strength and acceptable appearance. Both properties are degraded during weathering, a complex process involving interactions of sunlight, air, humidity, wind, rain and heat. Since the full effects of variable climates cannot yet be duplicated in the laboratory, outdoor testing is carried out at stations where extreme weather conditions are the rule. Fig. 1 shows the relative effects of outdoor exposure on three different Dow polyethylene formulations.

Accelerated aging (or weathering) test equipment is designed to accelerate the rate of aging – that is, to produce the same effects as the normal aging process in considerably less than normal time. Two widely-used devices are the "Fadeometer" and "Weatherometer." The Weatherometer uses a carbon arc with intermittent water spray; the Fadeometer an arc only.

An S-1 sunlamp is also valuable for conducting laboratory aging tests. Fig. 2 shows relative severity of accelerated aging equipment. Initial evaluation of Dow plastics is first made in the Fadeometer. Materials which retain good strength and appearance after 2000 hours in the machine are considered suitable for further testing outdoors.

In evaluating Zerlon® 150, a new Dow plastic, exposures were made in the Fadeometer, in Florida and Arizona. Changes in luminous transmission were plotted at varying time intervals for each exposure station. It was found that 1600-1800 hours in the machine produce the same effect on luminous transmission as one year of weathering at the outdoor stations. Similar relationships were found for certain other properties—such as impact strength – but without an across-the-board correlation. Although such relationships are close approximations, weathering data are still required.

It is possible to predict weatherability in areas having different climates by using a measure of langley units (actinic radiation of one gram calorie per cm^2). Exposures are first conducted in a selected area and property losses established as a function of the number of langleys (amount of incident light energy). Then, on a basis of pre-set requirements for residual strength and appearance, service life of the plastics material in other areas can be predicted by determining relative langley ratings for those areas.

Most plastics have good aging characteristics for indoor use. The two most significant factors in degradation are heat and light. For heat, the most important consideration is a safe continuous operating temperature. The effects of light are more varied, with the rate of degradation increasing as ultraviolet energy content rises. Neither incandescent nor fluorescent light degrades plastics appreciably under ordinary conditions, but even filtered sunlight contains relatively damaging UV levels, depending on severity of the climate.

Germicidal ultraviolet lamps commonly used in appliances can be harmful to component plastic parts. UV radiation is relatively intense, and the extent of damage encountered will depend on type, size and location of the bulb, and also the type of plastic chosen. Studies on property retention and light stability should be conducted with prototype parts prior to settling on a final material and finished design for full scale appliance production.

Dow Plastics Technical Service Engineers work with designers and plastics engineers, assisting in materials selection and providing information on design, molding and finishing of plastic parts. Also available are detailed data from continuing Plastiatrics Studies on weathering and aging of plastics materials. For these data, and for information on Dow plastics, write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept. 1804DT11.

FIG. 1 RELATIVE EFFECT OF OUTDOOR EXPOSURE ON POLYETHYLENE FORMULATIONS

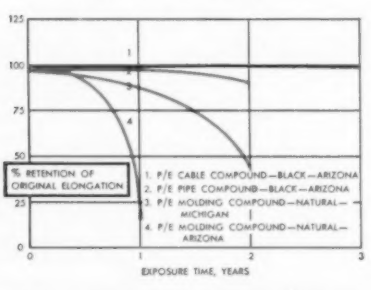
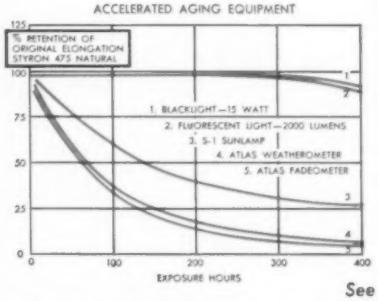


FIG. 2 RELATIVE SEVERITY OF ACCELERATED AGING EQUIPMENT



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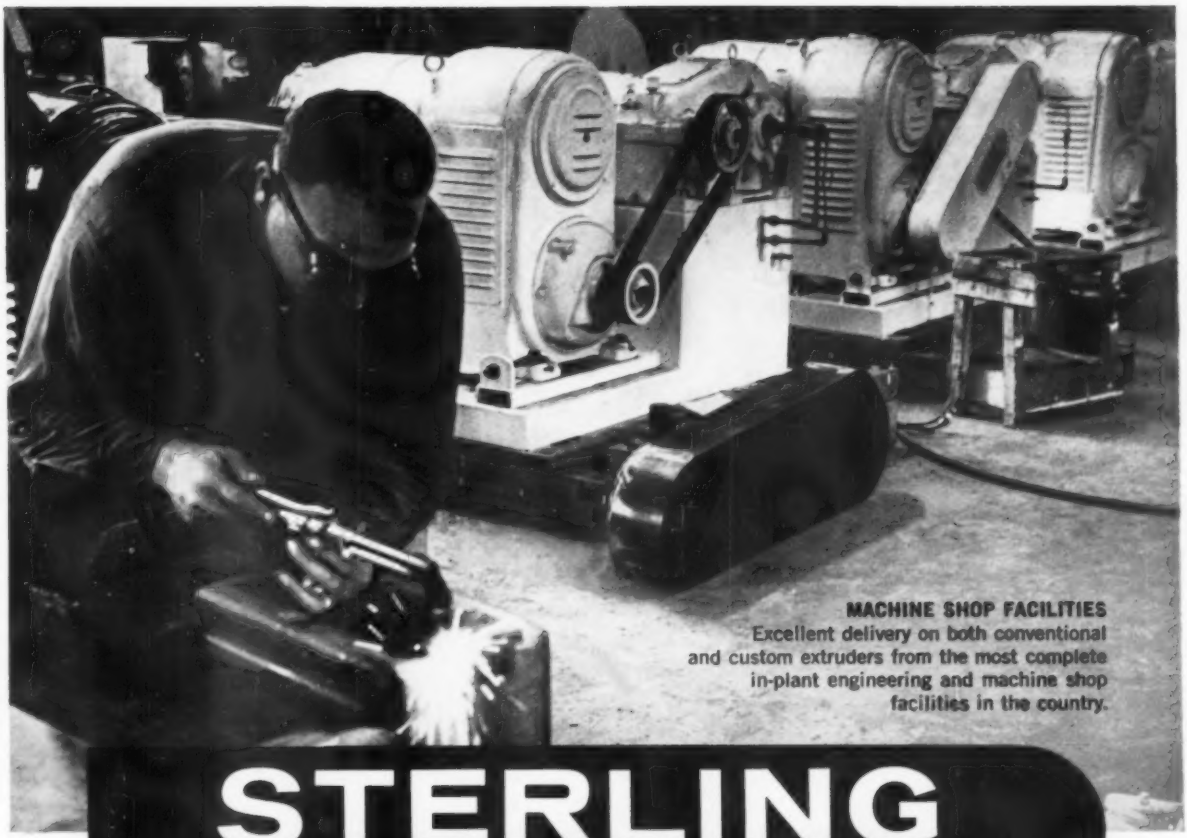

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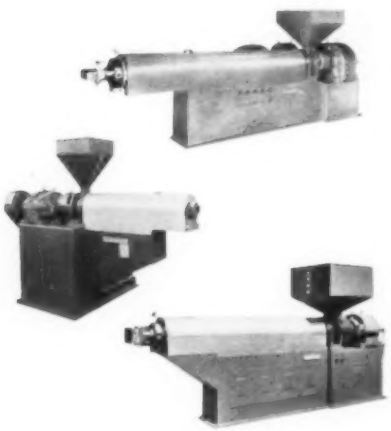

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- Exclusive engineering features, such as Sterling's improved floating thrust bearing and screw, which give our extruders the highest output available.
- Sizes from 1½" through 8" with L/D ratios of 21:1, 24:1 and 30:1.
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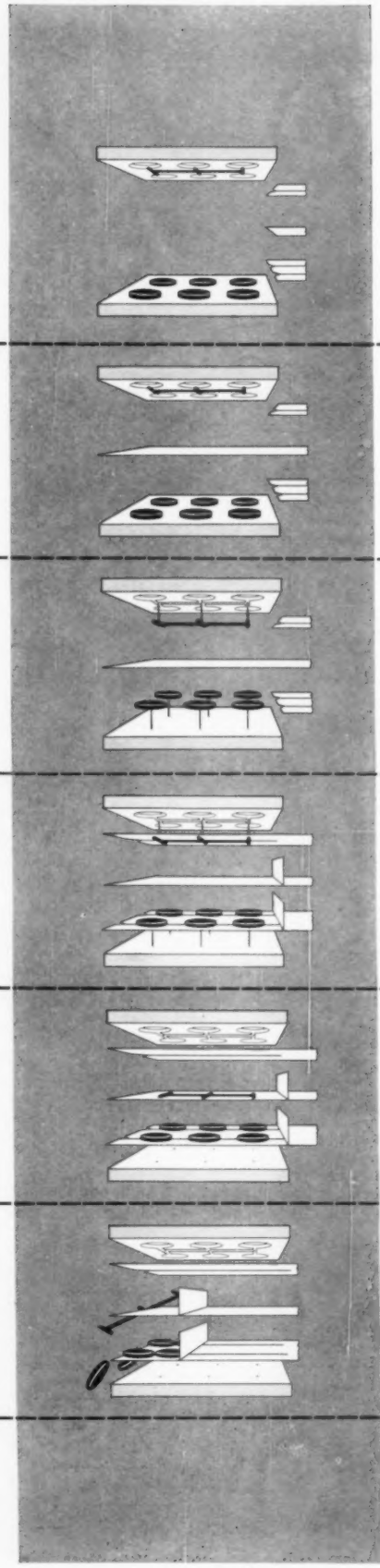


1. Press opens with molded parts positively retained in the lower die and the runner system in the upper die . . . thus accomplishing degating.

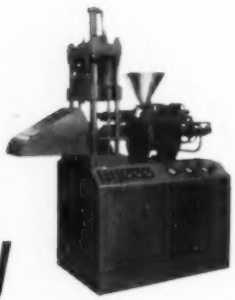
2. Separator plate moves forward under runner system.

3. Knock-out pins eject the parts and runner system.

4. Separate slotted combs for parts and runners move forward into stripping position.

5. Ejector pins are retracted, stripping parts and runner system. Parts remain on lower comb and runner system falls on separator plate.

6. Wipers assure controlled removal of parts from comb and runners from separator plate into separate chutes.



Only STOKES builds true automation into injection equipment...

- **operator is replaced . . . not merely eliminated at a calculated risk**
- **automation is paid for only once, not with each mold**
- **parts are automatically degated and positively ejected**
- **runners are discharged separately from parts and reground immediately**

Stokes built-in automation saves money, minimizes downtime, assures efficient operation and uniform parts production. More and more progressive molders are profiting with Stokes injection equipment. Let us explain how you, too, can profit. Write today for complete facts.

STOKES

Plastics Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia, Pa.

U.S.I. POLYETHYLENE NEWS

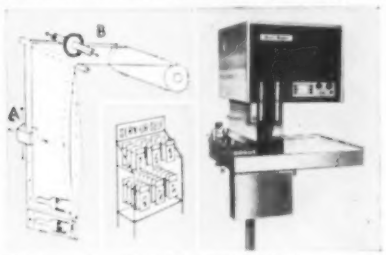
A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

Packaging Notes

"Rack-packaging" impulse buying items completely in one operation is now possible with this latest model, illustrated. *Packager-Sealer* which forms package around a product from open-end polyethylene film now comes equipped with two new accessories.

Using film with heat-sealed header, machine forms and seals package—while new *Register-Perforator* (A) punches ¼" holes in header at desired intervals, and new *Skip-Slit Perforator* (B) perforates along width of bag (top or bottom) for zip-off opening.

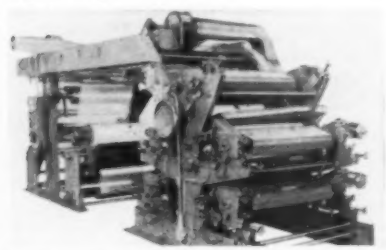
Machine with attachments saves one-half the cost of preformed bags, saves cost of grommets and grommeting operations, and reduces inventory of materials. Accessories also available separately.



(Photo courtesy See-Safe Machine Co.)

A compact, single-drum flexographic press, designed to meet the packaging industry's demands for close register color printing on narrow web widths of polyethylene, has recently been introduced. Reportedly, it is useful for shorter runs, incorporates principal features of larger flexographic presses. Cost is said to be comparable to that of many stack-type presses.

Standard equipment includes a 30" diameter single-impression cylinder with four color stations; new positive-locking device for color and plate cylinder frames. This device eliminates vibration, assures accurate adjustment and printing quality.



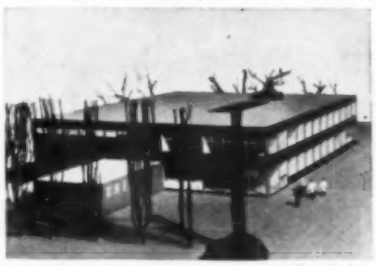
(Photo courtesy Hudson Sharp Machine Co.)

Polyethylene handles on 25-lb. multi-wall bags of granulated salt are being received favorably by consumers, according to a recent announcement. Injection-molded, the sturdy handles are simply sewn under the top tape during the ending operation. Bags need no special handling, as carriers lie back flat during filling, stacking, palletizing and shipping.

U.S.I.-International Constructing Offices and Laboratory in Baar, Switzerland

Will Help European Polyethylene Processors Expand Market, Improve Products

A new customer service laboratory and office building is currently being constructed at Sihlbruggstrasse, Baar, Switzerland, by U. S. Industrial Chemicals Company-International—officially incorporated October, 1959, as Sales and Development Company of National Distillers and Chemical Corporation (International) S.A. Temporary headquarters are at Kirchenstrasse 13, Zug, Switzerland. The new building in Baar, Canton of Zug, is scheduled to be ready for occupancy about July, 1961.



A model of the new laboratory and office being built by U.S.I.-International in Baar. The laboratory will be used to demonstrate best techniques for processing polyethylene.

Serves PETROTHENE Customers Abroad

The new facility will support the efforts of U.S.I.-International's representatives, through whom sales of PETROTHENE polyethylene resins will continue to be made. It will help them provide their customers with the close technical assistance which the polyethylene market demands. Experienced personnel will conduct research and evaluation studies to help improve products and develop new consumer markets. The United Kingdom, as well as European countries, will be served.

Well-Equipped Laboratory

The laboratory will be fully equipped with processing and test equipment designed to meet European standards and operating conditions. It will be used to demonstrate the best techniques for processing polyethylene into finished articles.

Polyethylene Used for Insulators in Nuclear Weapons Research

Two large polyethlene insulators, 18½ inches in diameter, have been made for use with a unique electrical switch in the discharge of heavy current loads from large condenser banks. Insulators and switch are reported to be part of research equipment used by nuclear physicists in the simulation and study of various aspects of nuclear weapons systems.

Polyethylene was chosen for its good insulating qualities, it is reported. Each insulator is said to be capable of withstanding voltages in the neighborhood of 100 kilovolts. The insulators were carefully milled to ensure design compatibility with the special two-million-ampere switch.

Milling polyethylene insulator for use with unique electrical switch in nuclear weapons research. (Photo courtesy Boeing Airplane Co.)

How to Build a Boat Shelter

To protect your boat against winter winds and snow, store it under polyethylene film. Lightweight, easy to handle, and inexpensive, it can be supported on a framework that's lighter and less expensive than the kind required by canvas coverings, according to the Canadian owner of a 37 ft. cruiser. He recommends building framework of bolted 2" x 2" lumber around the craft, covering it with 4 mil. black polyethylene, leaving a little slack. He makes vents in the roof, allows two feet between cover and ground.

U.S.I. Names New Vice-President

Paul J. La Marche has been made Vice-President of Production for U.S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation, it was announced by Robert E. Hulse, division General Manager and Executive Vice-President of the corporation.

Mr. La Marche joined the U.S.I. organization in 1949. Shortly afterward he became Manager of Sodium Sales. From 1951 to 1958 he was manager of the company's Ashtabula, Ohio, plants. He became Director of Production in October, 1958. Mr. La Marche is a graduate of Case Institute of Technology.

U.S.I.

Series V, No. 6

POLYETHYLENE PROCESSING TIPS

ANNEALING CHAMBER IMPROVES OPTICAL PROPERTIES OF POLYETHYLENE FILM

Clarity and gloss of blown polyethylene film are substantially improved by enclosing the blown tubing with an annealing chamber, or "chimney", located between the extruder die and air ring. (See schematic below.) The new technique has little significant effect on the strength characteristics of the film. It does, however, require closer control to maintain bubble stability.

The chimney, a development of U.S.I.'s Polymer Service Laboratory, can be made of inexpensive materials such as cardboard, glass or insulated metal. It can be constructed in two sections or hinged, to eliminate threading the "bubble" through the chamber.

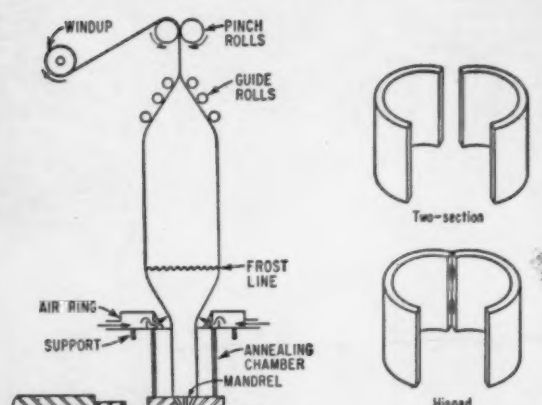
Although chamber diameter is not critical, best results are obtained with a chamber diameter 2" to 3" larger than the die diameter.

Importance of Retention Time

The degree of improvement in optical properties depends on retention time – the time it takes extruded film to travel from die lips to top of the chamber. This is a function of haul-off speed and chimney height.

A retention time of 2 seconds gives maximum optical improvement but requires a chamber height of 30" at haul-off speeds of 75 ft/min. This is not feasible from a production standpoint as serious blocking of warm film occurs and gauge is difficult to control.

With respect to production, a retention time of one second seems optimum. This gives significant optical improvement at more realistic chamber heights – 10"-14" – and haul-off rates – 50-70 ft/min.



Effect on Film Properties

Test results given in the accompanying table show that the annealing chamber improves the optical properties of film made from some polyethylene resins more than others. In both transmittance and gloss, low-density resins are improved more than higher-density resins; and higher-melt-index resins more than lower-melt-index resins.

An increase in blocking and reduction in slip may occur in some cases due to less time available for cooling. This can usually be corrected by increasing the distance between the die and the nip rolls, or by use of anti-block agents and higher slip formulations.

Technical Help and Data Available

U.S.I. engineers are continuing work on the annealing chamber study. They will be glad to consider your particular operation and help in adapting the method to your needs. You are also invited to write for a new paper describing the annealing chamber in greater detail. Address Technical Literature Department, U.S. Industrial Chemicals Co., 99 Park Ave., New York 16, N. Y.

How Annealing Affects Optical and Strength Properties of Film from PETROTHENE® Polyethylene Resins

PETROTHENE Resin	239-27 (5/MI; 0.929 density)		205 (3/MI; 0.924 density)		200-28 (3/MI; 0.916 density)		201 (5/MI; 0.916 density)	
Retention Time, Sec.	0	1	0	1	0	1	0	1
Haze, %	7.9	7.6	7.9	6.8	10.5	6.8	9.5	5.1
Gloss, %	10.2	11.8	10.9	12.3	7.5	9.3	6.9	10.4
Transmittance, %	68	72	54	61	38	57	39	70
Impact Strength Sand Bag, ft.	1	1.5	1	4	6	7.5	>9	>9
Dart Drop, g.	215	80	—	—	175	85	280	255
Elmen. Tear M.D.	175	140	165	60	65	40	60	45
T.D.	170	105	145	100	75	75	45	65

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities

Editorial: Today will be yesterday tomorrow

Another way of saying "Do It Now," as expressed by the late Oscar Hammerstein in the current Broadway musical "The Sound of Music." Repeated in thousands of ways, the sentiment remains the same and forever valid. Remember when nearly every public speaker, commentator, magazine writer, and market forecaster eulogized ". . . tomorrow's wondrous world of plastics?" That was only yesterday!

•

Today, plastics are firmly entrenched as design materials in most areas of production. The public no longer views them as "miracles of science" nor, happily, as "substitutes," but as products offering new and desirable features. Now is the time for careful thought and planning.

Have any of you ever said: "I'm getting a fair share of the business. I'm satisfied." I would certainly hope not! What you strive for and what you get can invariably be expressed in a direct proportion. With competition getting stiffer and some of the newness wearing off the plastics label, what can be done to gain a larger share of markets for plastic materials?

Let's take one phase of plastics applications —packaging. National Family Opinion, Inc., recently conducted an extensive survey of 1,089 housewives on food packaging. Plastics really scored high for frozen fruits—45% preference; dairy products—49%; and frozen vegetables—a 38% preference. This is very good, but what about the other 55%, 51%, and 62%— why can't plastics make further inroads?

Only 12% of the housewives favored plastic juice containers; 3% for canned fruits and vegetables, and 12% for dry cereals. What can be done to raise these percentages?

First, know your customer. Don't guess. Housewives do not like set-in lids, outsize packages, round containers, glued-down tops, key-opened tins, flat rimless cans, and pry-off lids. What they do like are squeeze bottles, pouring spouts, screw tops, inner wraps, premeasured packs, re-usable containers, and see-through packages. All of these features are, or could be made available in plastic.

Here's the problem. If the mechanics of increasing your share of the market were as simple as the directions, we would all be millionaires. The basic approach requires but three factors: know your customer—his likes, dislikes, and what he would like to see but hasn't. Select your material based on its process and end-use properties. Design your product within these limitations.

•

Sales Management, our associate magazine in marketing, ran the National Family report in three parts. Should you wish a copy of the complete report, it is available at $1.00 per copy. Along similar lines, our December issue will carry a comprehensive article on the current and potential markets for urethane, vinyl, and latex rubber foams.

Jim Dugan

Editor

DONALD L. MILLER

Joe Foster, President, talks about Foster Grant's unique experience in plastics.

"What we give away is more valuable to our customers than the resins we sell," says Joe Foster.

To put it in a nutshell—we're problem-solvers!

Need a color matched? We can match it precisely—and **fast.** Need marketing advice? Foster Grant's long experience as a molder of finished plastic articles is at your disposal. Or maybe we can help trim your cycling time by mold re-design or machine improvements.

We're **able** to solve our customers' problems because we've piled up a lot of know-how over the years. We had to. Back in the old days, there wasn't any hydraulic molding...there wasn't any lubricated plastic... there wasn't even injection molding in this country. To improve our own operation, we developed all that—and more.

As we led the way, we learned plastics. Inside and out. Today, many Foster Grant advances are standard industry practices. Maybe our unique position as **the only resin supplier with molding experience** can prove as valuable to you as it has to our present customers for styrene monomer, and polystyrene, impact polystyrene and Nylon 6 resins.

Why not call or write us today. Foster Grant Co., Inc., Leominster, Mass., KEystone 4-6511.

FG

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PRODUCTS
younger
longer

HARCHEM SEBACATE PLASTICIZERS

Keep your vinyl products from showing their age in use and they'll keep building good will and good volume for you.
Harchem Sebacate Plasticizers give vinyls built-in resistance to heat, cold, water or physical abuse.
Harchem offers four Harflex Sebacic Acid Esters. Check the list below for the one best suited to fight aging, weathering and wear for you.

will
do it!

Plasticizer	Specific Gravity 25°/25°C ±.003	Viscosity 25°C, cps	Compatible With	Outstanding Characteristics
Dibenzyl Sebacate	1.055	21-22	Polyvinyl Chloride and Copolymers, Polyvinyl Butyral, Synthetic Rubbers	Excellent Solvation, Very Low Volatility, Permanence, Good Electricals, Low Temp. Flexibility
Dibutyl Sebacate	0.935	7.9	Vinyl Resins, Cellulose Acetobutyrate, Synthetic Rubbers, Rubber Hydrochloride, Polymethyl Methacrylate	Low Temp. Flexibility, Excellent Aging Qualities, Non-Toxic
Dimethyl Sebacate	0.986*	3.54 @30°C	Vinyl Resins, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate, Acrylic Resins	High Solvency and Efficiency, Wide Compatibility, Concentrated Source of Sebacyl Radical
Dioctyl Sebacate	0.913	17.4	Polyvinyl Chloride and Copolymers, Polyvinyl Butyral, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate	Excellent Low Temp. Flexibility, Low Volatility, Excellent Soapy Water Resistance, Good Electricals

*30°/20°C

WRITE FOR SAMPLES AND BULLETIN

THE KEY TO HARCHEM® BETTER PLASTICS

HARCHEM DIVISION

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DOW | RESINS

BRINE LOSES ITS BITE

When "reefer" hatch covers are preform moldings

Refrigerator car hatch covers take a beating from weather, hard use, and corrosive brine. Preform molded polyester hatch covers prove they can take it, and save money for the user, as well!

The Plastics Division of General American Transportation Corporation preform molds the durable hatch covers shown above for Standard Railway Equipment Manufacturing Company. The results are economical covers with excellent resistance to weathering and to the attack of salt; they won't warp or lose their strength and they last the life of the car with little or no maintenance.

Reinforced polyester moldings are low in cost, too. Nearly any configuration can be molded, greatly reducing the number of costly production operations normally required by other materials.

Preform moldings offer advantages in cost, in production ease, in long life under difficult service conditions; and the types of products for which they can be used are virtually unlimited. The Dow Chemical Company supplies the basic monomers for polyester resins for premix, preform and mat moldings—Dow styrene and Dow vinyltoluene.

For information on these Dow monomers, write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Department 1967DT11.

See "The Dow Hour of Great Mysteries" on NBC-TV

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

NEW FROM EASTMAN

TENITE Polyethylene is now available in formulations containing a new ultraviolet inhibitor that gives them superior resistance to sunlight and weathering

- **Exposure tests prove the superior durability of polyethylene film, sheet and moldings stabilized with new Eastman inhibitor**
- **Effectiveness is not impaired by molding or extruding temperatures up to 600° F.**
- **Stabilized film retains a high degree of clarity, flexibility, smoothness and toughness**
- **The new inhibitor markedly extends the useful life of polyethylene film for greenhouse glazing...silo, storage and machinery covers**

TENITE SALES OFFICES:
Atlanta, Chicago, Cleveland, Dallas, Dayton, Detroit, Greensboro (N. C.), Kansas City (Mo.), Leominster (Mass.), New York City, Philadelphia, Rochester (N. Y.), St. Louis, Toronto.

WEST COAST REPRESENTATIVE:
Wilson & Geo. Meyer & Company, San Francisco, Los Angeles, Portland (Ore.), Seattle.

New, specially stabilized Tenite Polyethylene formulations for extrusion into thin, transparent, weather-resistant film are now available from Eastman. Incorporated in the resins is a new non-pigment ultraviolet inhibitor developed by Eastman chemists.

The effectiveness of the inhibitor is not impaired by molding or extrusion temperatures as high as 600°F. This, too, represents an improvement over polyethylene formulations stabilized with previously available ultraviolet inhibitors.

Film only 5 mils thick, extruded from a typical Tenite Polyethylene formulation containing the new inhibitor, has withstood two years of continuous outdoor weathering with little loss of strength. Results of tests on the exposed film show that it retained more of its original properties after 24 months' exposure than film of unstabilized polyethylene retained after only 12 months' exposure.

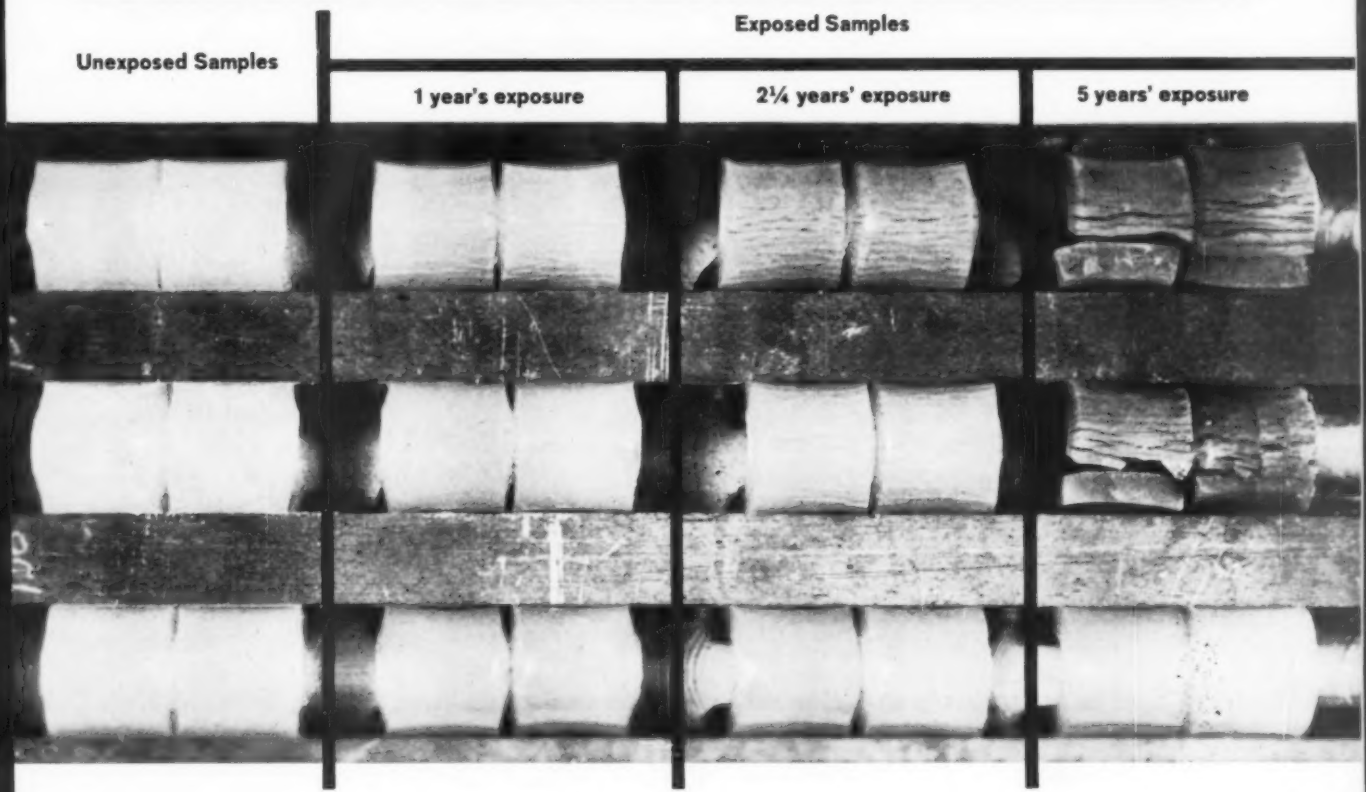
Specifically, the stabilized film retained a high degree of original clarity, and remained smooth, pliable and tough.

The demonstrated superior performance of the new stabilized resins greatly extends the usefulness of polyethylene film in such outdoor applications as glazing for greenhouses, and protective covers for silage, machinery and other outdoor-stored materials.

Eastman also supplies a stabilized Tenite Polyethylene formulation for extrusion of sheet 50 mils or thicker as well as for injection molding of heavier sections. In weathering tests recently completed, 50-mil sheet of this material retained 88% of initial elongation after three years of outdoor exposure. Heavier sections (125 mils), weathered under stress, still retained their good appearance after five years. Such results indicate that polyethylene sheet and molded parts can be expected to resist the elements two to three times as long as was previously possible.

For further information on Tenite Polyethylene formulations stabilized with the new ultraviolet inhibitor, contact any of the Tenite sales offices, or write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

WEATHERABILITY OF STRESSED TENITE POLYETHYLENE



Pictures are better than words!

Here is an unretouched photograph showing a test rack of stressed molded specimens after 5 years of continuous exposure in Tennessee. Specimens were 125 mils thick and were molded from a typical base formulation of Tenite Polyethylene. The photograph forcefully illustrates the effectiveness of Eastman's new ultraviolet stabilizer.

TENITE®
POLYETHYLENE
an Eastman plastic

Bubble Trouble?

Good air release and bubble break in plastisols mean an end product free of imperfections. The new Mark BB stabilizer just developed by Argus solves this problem better than any other stabilizer available.

Mark BB is a multi-purpose stabilizer. In addition to its excellent bubble break properties, it gives outstanding heat and light stability, low viscosity, and viscosity stability throughout processing.

What's *your* current problem? Bubble break? Low temperature stiffening? Toxicity? Getting better resistance in electrical compounds at less cost? Lack of clarity in rigids?

Don't sit with it. Simply call Argus. Chances are the answer lies in one of our present Mark stabilizers or Drapex plasticizers. If not, we'll find it for you in our lab.

Argus Has the Answer

Technical bulletins and samples on request

ARGUS CHEMICAL Corporation 633 Court Street, Brooklyn 31, N.Y. Branch: Frederick Building, Cleveland 15, Ohio

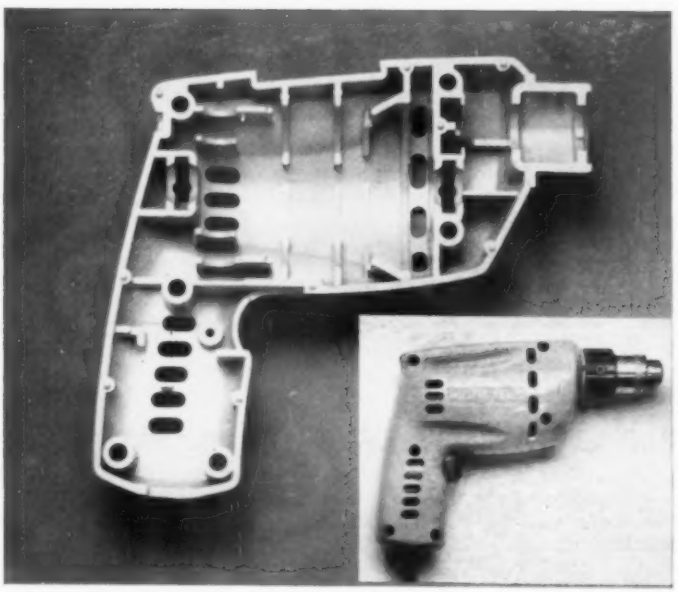
Rep's.: H. M. Royal, Inc., 11911 Woodruff Ave., Downey, Cal.; Philipp Bros. Chemicals, Inc., 10 High St., Boston; H. L. Blachford, Ltd., 977 Aqueduct St., Montreal.
European Affiliates: SA Argus Chemical NV; 33, Rue d'Anderlecht, Drogenbos, Belgium – Lankro Chemicals, Ltd.; Salters Lane, Eccles, Manchester, England.

DU PONT

Better Things for Better Living
. . . through Chemistry

PLASTICS PROSPECTS

Expanding use of ZYTEL® opens new market opportunities for molders



New Millers Falls drill housing of ZYTEL® brings design improvements

The insulating properties of ZYTEL nylon resins make possible a drill housing that helps protect against shock hazards. In addition, this rugged and durable housing of ZYTEL is 20% lighter in weight than a comparable housing of aluminum. It is self-extinguishing. It stays comfortable to the touch in hot or cold weather, even after prolonged use. The two halves of the drill housing are molded quickly and easily by the molder. The choice of ZYTEL 31 assures good dimensional stability of the moldings, and permits a perfect match of each half for screw inserts, assembly and flange matings. No machining is necessary.

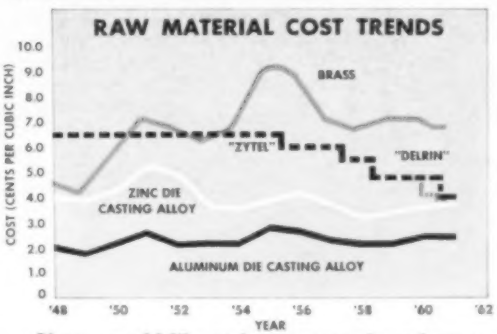
The manufacturer, Millers Falls Company, of Greenfield, Mass., reports that extensive field tests of the new drill have proved its excellent service life. The new drill also has a black collar and lock switch made of Du Pont DELRIN® acetal resin—chosen for its exceptionally good dimensional stability.

The need for improved product performance and lower costs is turning more and more manufacturers toward plastics as replacement materials for metals. Engineering plastics such as DELRIN® acetal resin and ZYTEL® nylon resins are opening vast new sales opportunities for injection molders.

The story of the new Millers Falls drill housing, at left, is a case in point. The total opportunities for the economical use of ZYTEL in the field of small power tools have hardly been tapped. In sporting goods, plumbing fixtures, mechanical applications, hardware items and many other areas, the growth of applications of ZYTEL is rapid, and offers molders opportunities for an expanded volume of business.

As prices of DELRIN and ZYTEL have continued to drop and those of aluminum, zinc, brass and other metals have continued upward, the market for parts of plastic has expanded. The chart shows these materials-cost trends.

Since parts molded of plastic require little or no finishing in comparison with costly finishing operations on metal, even when only moderate finishing is required, the completed-part cost in plastic is often lower. When the properties of the plastic fit, the business is there.



If you would like to know more about how to find business in this expanding market, please write to: E. I. du Pont de Nemours & Co. (Inc.), Dept. FF-11, Room 2507Z, Nemours Building, Wilmington 98, Delaware.

In Canada: Du Pont of Canada Limited, P. O. Box 660, Montreal, Quebec.

POLYCHEMICALS DEPARTMENT

Du Pont's problem-solving engineering materials:

ALATHON® polyethylene resins | DELRIN® acetal resin | LUCITE® acrylic resins | ZYTEL® nylon resins

PLANNING PROFITS PROFITABLY

DEMANDS THE OPTIMUM IN EQUIPMENT ABILITY, FLEXIBILITY AND RATE

Across more than 25 years of specialized service to the manufacturers of the best in plastics and synthetic rubber materials, the unique WEI dual worm design has played a major role in the improvement of compounding-devolatilizing-extruding methods.

It meets on the most confidential and trusted terms with the men who must plan profit profitably . . . and does a superior selling job because it can laboratory-prove a production line ability that replaces engineering claims with comprehensive deeds for all to see* *and approve!*

To look back on our long, hard trail of experience serves one indisputable purpose. The reviewing reinforces the accomplishments of the future in the engineering and manufacture of specialized dual worm all-in-one-operation plastics processing equipment with production dimensions consistent with the boldest plans in the plastics field . . . Plans that wear the best known trademarks! WEI appreciates that confidence and will continue to produce equipment engineered to make the most of your future.

**Classified viewing, to be sure*

Welding Engineers Improved-Profit All-In-One-Operation Compounder-Devolatilizer-Extruders Are Designed To Operate at Maximum Capacity and Cut Your Labor Requirements In Half!

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WELDING ENGINEERS
E

Welding Engineers, Inc., Norristown, Pennsylvania. Manufacturers of Processing Equipment for the Chemical Industry
U.S. West Coast Sales Representatives: Machinery Sales Co., Los Angeles 58, Calif.
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Far East Sales Representatives: Marubeni Iida Co., Ltd., Tokyo, Japan

PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

Control of variables in heat resistant glass reinforced plastics

. . . . . and how these variables affect processing-techniques

RALPH H. SONNEBORN*
ALLAN B. ISHAM*
FRANK W. DENNEN*

Fibrous glass-reinforced plastics have demonstrated structural capabilities for continuous use at temperatures as high as 500° F. However, variations in their properties have forced designers to use low design values. This is especially detrimental in high performance applications. Industry needs factual information on the effect of the materials and process parameters so that they can be measured and controlled. Such information should improve the molded part quality by increasing its reliability and allowing a wider, more effective use of the material.

A program was established to study the variables associated with the materials and processing techniques in order to develop quality control procedures for reinforced high-temperature plastic parts. It also provides basic engineering data for the designer; processing information over a wide range of materials and conditions for the fabricator.

The program was studied in four phases: component materials—the critical variables in both the glass fiber and the resins; process variability—the effects of layup procedures and other fabricator processes and techniques; evaluation—the physical, mechanical, and electrical properties for the panels fabricated according to the techniques of Phase 2 (at the same time, integration of Phases 2 and 3 showed how these properties were affected by changes in fabrication techniques and molding conditions); and inspection for defects, resin, content, density, thickness, strength, electrical properties, and variations of these throughout the part. Non-destructive testing methods were also studied.

The comprehensive nature of this study precludes a detailed discussion in this paper. A complete report has been issued under the same title and is available from the Armed Forces Technical Information Agency or from the Office of Technical Services, U. S. Department of Commerce.

* Reinforced Plastics Laboratory, Owens-Corning Fiberglas Corp., Granville, Ohio

Interdependence of Variables

An important fact demonstrated by this study was the interdependence of the variables, i.e., the phenomenon of a variable having a different effect on panel properties at different levels of a second variable. The occurrence of these interdependencies (or interactions) was shown in Phase 2, where 37% of the process variable effects were of the two-variable interaction type.

A two-variable interaction is shown in the following example. In the vacuum bag molding of 181/Volan A fabric with Paraplex P-43 polyester resin, two operators were used, and two laminate thicknesses were made. The flexural moduli at 160° F. (in millions of psi.) were as follows:

	5 Plies	*13 Plies*
Operator A	3.48	2.88
Operator B	3.30	3.48

Thus, operator A made slightly better 5-ply panels than operator B, but B's 13-ply panels were much better than A's.

Knowledge of the frequent occurrence of interactions shows that the simultaneous consideration of all parameters is necessary for proper understanding and use of reinforced plastics. It applies to all facets: research, design, manufacture, and specification. To take advantage of this knowledge, a "systems approach" is neces-

sary. This recognizes that different interrelations of the process parameters may exist for each property of reinforced plastics.

There is not necessarily any best individual reinforcement, best resin, best finish, etc., but rather that there is a best system of parameters and process conditions for each set of target properties! The recognition of this approach to reinforced plastics is not new. It does show, however, that this applies to reinforced plastics as a whole and not exclusively to one area of investigation, such as cure cycle or resin preparation.

Strength Uniformity

The standard deviation for a given property measures the uniformity of strength achieved with that resin-process system. Analysis of these standard deviations from the experiments of this program shows that preimpregnated fabric laminates are a little more uniform than fabric laminates made from liquid resins. The best strength uniformity was obtained with silicone, high pressure phenolic, and heat resistant epoxy resins. There was no difference in the strength uniformity of the various molding processes. Compressive and tensile strengths had the lowest average variation; flexural strength the highest. The rating is valid on both an absolute and a percentage basis.

Sensitivity to Process Variables

The major conclusion of analyzing for sensitivity to variables is that no resin-process system appears to be more or less sensitive than the others. For all resin-process systems, at least one process variable affected the laminate properties significantly. Some systems were affected by as many as five variables. Since different types and numbers of variables were studied for each system, the actual number of significant variables found is not highly important and more could probably have been found.

Importance of Variables

Some variables and parameters were found to have no significant effect; others were critical. At all times, it should be remembered that the variables were studied within specific ranges. Extrapolation could easily lead to erroneous conclusions. Also, the effects of many are interacted with other factors. Those that affected all resin-process systems to some extent, or most systems to a critical degree can be classified as having a major effect. They are: fabric weave style, fabric finish, yarn or roving finish, yarn twist, number of turns or plies, molding temperature, molding time, molding pressure, postcure time, postcure temperature, and catalyst or curing agent.

Minor effects are those that are critical for one or two systems, or have a barely significant importance for several. These are: contamination, mechanical working, operator, warp end count, air content of resins, impregnation time, delay between cure and postcure, catalyst/curing agent concentration, material age, strand yardage, prewarmed winding mold, panel size, specimen position, and removal of resin flash before postcure.

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Some of the variables were found to be of little or no significance within the range studied. These are classed as having negligible effect, and are as follows: fabric nesting, panel cooling rate, minor damage to reinforcement, rate of pressure application, preheating prepreg, pressure delay in molding, ply skewness, relative humidity, pot time, pot temperature, excess resin in wet layup, precure pressure, "bumping" during cure, and mold release.

Sensitivity of Properties

The experiments on process variables were analyzed for the frequency of variables affecting each type of laminate property. No one property stands out as being particularly sensitive to the variables. The properties affected 30-40% of the time, i.e., the most sensitive properties, were: flexural strength—dry, wet, and hot; flexural modulus—dry, wet, and hot; tensile strength—dry, wet, and hot; and compressive strength—hot.

The dry and wet compressive strengths were affected 18-20% of the time, and hence can be termed least sensitive. Specific variables which affected flexural properties were not necessarily the same ones which affected compressive properties. This applies also to the other properties and leads to the conclusion that there is no single property which can be considered as a general criterion for the importance of a variable or parameter.

Thickness Effect

In the process variability experiments, a variety of laminate thicknesses were made, controlled by the num-

ber of fabric plies. Three general levels of thickness were investigated: nominal 1/16 inch, nominal 1/8 inch, and nominal 3/8 inch. The effect of changing the number of plies often depended on the levels of other process variables. However, the overall effect of number of plies is given as follows: compressive strength usually increased with an increase in number of plies; flexural strength usually decreased with an increase in number of plies; flexural modulus usually did not change with an increase in number of plies; and tensile strength had no general correlation with number of plies—the effect was erratic.

Glass Content Effect

The proportion of glass reinforcement in a laminate is important. It has been demonstrated many times that there is an optimum content for each property. The glass content for best tensile strength is highest, for compressive strength lowest, and for flexural strength in between (for fabric reinforced laminates).

Many variables in this study were shown to have important effects on the laminate properties but, in some cases, these effects were difficult to separate from those caused by changing the glass content. For example, if molding pressure is being investigated, there are usually changes in reinforcement content. Conversely, it is almost impossible to vary the glass content without also varying some material or process variable to cause this change. Thus, the separation of parameter or variable from the amount of reinforcement could not be achieved by experimentation.

Subsequently, a mathematical analysis was made of the most useful data (a form of covariance analysis). It showed that some of the variables acted independently of the changes in glass content. For example, molding pressure, the use of stops or jigs in press molding, and mechanical working of wet layups produced important effects on strength, but primarily by changing the glass content. Such variables as cure times and temperatures, number of plies of fabric, and different operators yielded strength changes which usually had little to do with glass content changes. Interestingly, many of the variations in methods of applying the fabric finish affected laminate strengths—partially through changing glass content, and partially through the variable itself.

Choice of Materials

When using reinforced plastics, the designer should specify not only the raw materials, but also the methods of molding the materials he chooses on the basis of end product requirements. The choice of molding method may, in some cases, have a distinct bearing on what materials should be selected. The type of catalyst or curing agent to be employed with a specific resin must also be considered. Quite frequently, with liquid resins, the choice of curing agent has a direct relation to the performance of the part. Generally, the designer will not be concerned directly with curing agents when prepregs are involved.

Reinforcement

Uni-directional reinforcements are available in the form of rovings and yarns, which can be used directly with any liquid resin or preimpregnated with resins requiring "B-staging." "Uni-directionality" permits strength orientation in the direction of greatest stresses, but by definition, its use is almost restricted to some form of the filament winding process. Use of solid or "B-staged resin system with fabric can be difficult or impossible, depending on the shape to be encompassed. A parallel strand construction is sometimes easier to lay up in this type of molding if the resin is properly specified.

For rovings, several varieties of sizings are available, so the choice will depend on the type of resin employed. Type 880 sizing, for instance, is one of a series most suitable for polyesters. There is a wider variety of choices to be made in considering the use of fabric reinforcements. Usually, fabrics are more convenient to handle than parallel strands in high performance applications. The fabrics studied fall into three categories: 143 fabric—4-harness satin, unidirectional strength pattern; 120 fabric—4-harness satin, bidirectional strength pattern; and 181 fabric—8-harness satin, bidirectional strength pattern.

It is common practice to modify the strength pattern of a fabric laminate by rotating some of the plies by angles of from 30 to 90 degrees. The coupling agents applied to fabric come in as wide a variety as sizings on rovings. The following table gives a general comparison of results for the various resin vs finish investigations. No one finish is a universally superior performer nor is any one finish completely unacceptable.

Resin	*Best Finishes*
Paraplex P-43	Volan A and A-172
Vibrin 136A	301 and Garan
Epon 828/CL	Volan A
Epon 1031/BF_3MEA	301
Conolon 506	Volan A
CTL 91-LD	A-1100
DC 2106	112

AMOUNT OF REINFORCEMENT. Over a wide range of values, the glass content of a laminate determines its strength. Within narrow limits, other factors come into play and glass content becomes less important. Originally, however, the designer must determine his strength requirements and specify enough glass of the proper characteristics to meet them.

Resin Selection

Resin selection is dictated primarily by the temperature and strength requirements of the product. Beyond that, the major decision involves choosing between the wet layup system and the dry layup using preimpregnated fabrics. Conventional polyesters are restricted to applications not requiring prolonged exposure to temperatures much over 160° F. A heat resistant polyester maintains creditable strength at 500° F. for many hours.

The two epoxy resins studied were a conventional liquid and a heat resistant solid. Epon 828 cured with CL performs well at 300° F., with indications that 500° F. performance is practical with NMA curing agent. Epon 1031 is designed to maintain its strength at

temperatures up to 500° F. Both phenolic resins studied and the silicone resin are prepreg systems. The silicone is indicated when good electrical properties at high temperatures are required. Conolon 506 and CTL 91-LD phenolics are aimed at good 500° F. mechanical performance.

Catalyst or Curing Agent

Many catalyst and curing agent systems are available. In some cases, cures can be effected without the use of heat other than that generated exothermically. The conventional and heat resistant epoxy resins were tested using several curing agents, many of which had a distinct effect on the resins' handling characteristics. CL curing agent, for instance, is too reactive to be used with Epon 1031. Some curing agents require the use of an added catalyst, or stringent postcures. Properties are affected appreciably by the choice of catalyst, but not all properties are affected in the same way.

An impregnation-variables study of Epon 1031 showed definite effects of the curing agents on both B-stage resin characteristics and impregnation conditions. Strength effects in the molded panel were also noted. With Paraplex P-43 polyester resin, the best results were obtained using benzoyl peroxide catalyst with heat.

The question of curing agents does not arise with phenolic prepregs and, in the case of DC 2106 silicone resin, catalyst is incorporated into the system prior to impregnation. Changes in catalyst concentration had a very minor effect on laminate properties.

Reinforcement Variables

STRANDS, ROVINGS AND YARNS. The major variables associated with these uni-directional materials are yardage (or strand diameter) and glass content. Using the parallel strand molding technique, the flexural strength of the bars was increased slightly as the yardage decreased over the range from 475's to 125's. Within the range of commercial reinforcing fibers, filament diameter (per se) has no effect on the strength of individual fibers; but does affect the ease of fiber wetting—probably as a result of differences in the density of packing of the filament, and blocking of the resin by the glass surface treatments.

The optimum glass content for parallel strand bars is 80-85% by weight. Yardage variation within normal production tolerances does not affect strength since a variation from 200's to 250's yardage changes the flexural strength by only 4.2 x 10^3 psi. This applies to rovings as well as to strands. Figure 1 shows the effect of yardage on the flexural strength of parallel strand bars. Fibrous glass roving normally has a yardage of 130 x 10^2 yards per pound. Yarns offer the performance pattern of strands or rovings, except that their overall strength level is higher. This is the result of the differences between a finish (yarn) and a sizing (strand), and also the better tension control with the yarn. The size-removal heat treatment given to yarns may also be beneficial. The twist at the low level used in yarns (1.0 turn per inch) has no effect on strength.

FABRICS. Variables connected with cloth are yardage, twist, warp end count, and quantity of glass. A fifth factor, weave style, specifies the above elements plus the manner in which the yarns are combined.

The final phase in preparing fabric for molding involves the application of a coupling agent to the bare glass. This introduces the variables of finish type and amount. The latter is normally covered by manufacturers' specifications; in the cases of some of the newer finishes, solids concentrations are not firmly established.

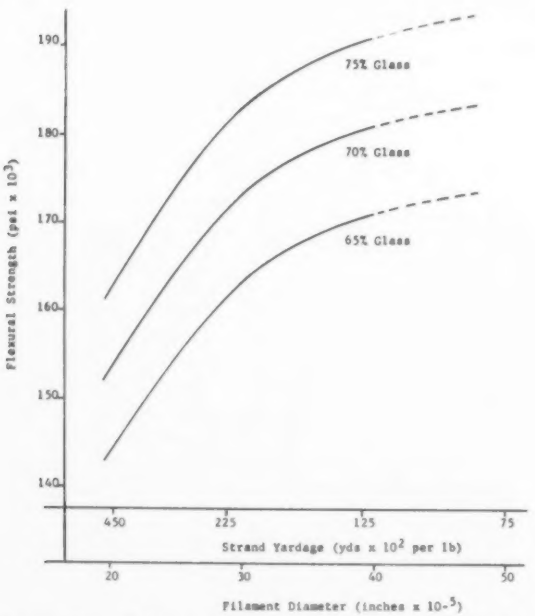

Fig. 1. Effect of filament diameter on flexural strength of parallel strand bar moldings. Resin: Paraplex P-43 conventional polyester with 10% added styrene. Catalyst: 1% benzoyl peroxide crystals. Reinforcements: Fibrous glass strands with 803 size Cure: 15 minutes at 225° F. to stops.

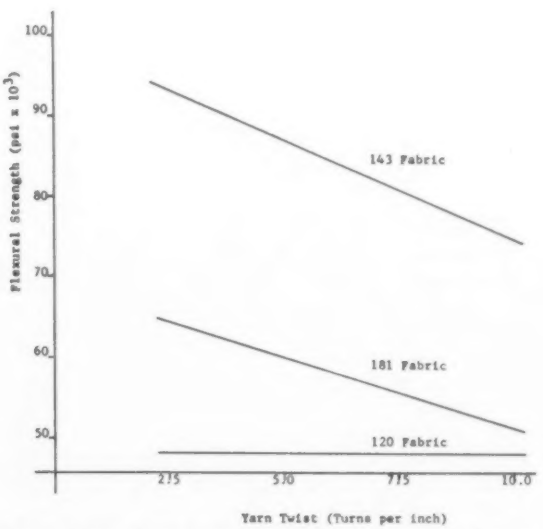

Fig. 2. Effect of yarn twist on the flexural strength of press molded laminates. Resin: Paraplex P-43 conventional polyester with 10% added styrene. Catalyst: 1% benzoyl peroxide crystals. Reinforcement: 143, 181, or 120 glass fabric with Finish 139. Cure: 30 minutes at 210° F. to stops.

YARDAGE. The effect of this variable is analogous to its action on uni-directionally reinforced laminates. There is no significant effect of yardage on strengths within tolerance limits around a nominal, but expanding to cover the range studied (125's to 475's) would probably show a considerable effect. However, the larger range of yardages cannot be covered except by changing weave styles, and this introduces other considerations such as weight or construction of yarn, direction of major strength, ends per inch of warp and/or fill yarns.

TWIST. Enough variation in twist was studied to prove that, all else being equal, the lowest twist gives the best laminate properties. This is shown in Figure 2 for the flexural properties of press molded, fabric-reinforced panels.

WARP END COUNT. Fabric 181 is sensitive to reduction of ends per inch—strengths are generally reduced. With 120 fabric, reducing the ends per inch increased the 30-day wet compressive strength. No other performance characteristics of this fabric were affected. It is inferred that 143 cloth would be affected adversely by reducing the number of ends per inch, since the warp yarns are quite heavy and a small reduction would be relatively larger than with either 181 or 120. This factor was not studied with 143.

GLASS SURFACE TREATMENTS. Batch heat cleaning is the currently accepted method of size removal. Continuous heat cleaning and chemical systems are experimental, and have not produced fully satisfactory results as yet. The commonly used commercial finishes studied were: Volan A (chrome), Garan (silane) and A-1100 (amino silane). Not every finish works identically with every resin, but each has certain advantages relative to specific properties. Certain conditions were recommended as being beneficial in the finishing operation. Normal process control based on these recommendations will result in a minimum of uncontrolled variation in laminate properties.

Resin Variables

Generally speaking, the manufacturing variables encountered by resin producers are quite well controlled. The specific effect of each individual manufacturing variable is very difficult to determine because of the interactive effects. Strict process control by the resin manufacturer will keep the effects of the variables at a controllable minimum so long as the molder keeps his process under careful control.

Process Variables

There are many detailed aspects of molding that a fabricator can vary at his discretion—all independent of materials and process choice and all of which can exert great influence on the performance of molded parts. In many cases, a variable was particularly influential for one or two panel properties, or with a specific resin, or for only one process. There are two reasons for this. The ranges studied were different for each resin process system and, because of the heterogeneous nature of reinforced plastics, each system has different critical aspects which are not necessarily similar or even analogous.

Because of the multitude of process variables and the critical aspects of each system, a design known as fractional factorial experimentation was used to investigate process variables for 29 systems. A basic outline for one of these experiments (Design 2^{7-3}) is reported as follows:

Resin system: CTL-91 LD
Process: Matched die, no stops
Fabrics: 143 and 181, A-1100 finish
Number of panels: 16 factorial plus 4 duplicates
Thickness: Nominal 0.125 in. and 0.375 in.
Number variables: 7

Factor	Variable	High Level	Low Level
A	Panel breathing	(1)	(2)
B	Fabric plies	39	13
D	Molding temperature, °F.	300	270
E	Molding pressure, psi.	300	100
F	Molding time, min.	20	15
G	Postcure time per step, hrs.*	24	15
H	Fabric weave	143	181

*The time shown at 300°F, followed by the time shown at 350°F.

Notes:
(1) Release pressure for 5 seconds after 3 minutes and after 5 minutes of cure time.
(2) Contact pressure only for 4 minutes, then apply full pressure; at 5 minutes of cure time, release pressure for 5 seconds.

Variables were held at one of two levels for molding the laminates. In the analysis, the effects of each variable was determined at both levels of all other variables.

REINFORCEMENT HANDLING. Glass fibers can be damaged in handling due to their self-abrasive charac-

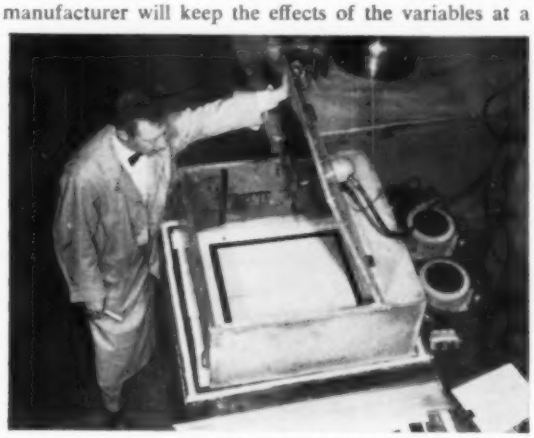

Fig. 3. Press molding.

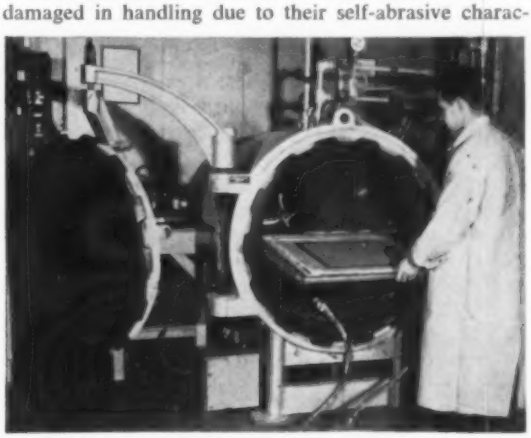

Fig. 4. Vacuum bag molding.

teristics. A study of the damage inflicted on continuous strands by the roving operation showed that this damage did not affect the strength of parallel strand laminates. Fabric was purposely abraded to give 25% lower tensile strength and then vacuum bag molded with a liquid polyester resin. When the panels were well wet-out, the damaged fabric gave the same properties as undamaged fabric, but the flexural strengths were reduced when the impregnation was not as thorough.

Nesting, or turning over alternate plies of fabric in a laminate, gives the best possible fiber packing. With conventional structural laminates, this did not affect the mechanical properties. Alternate plies of 181 fabric were placed at 5° and 10° from the true warp to determine the need for controlling the parallelism of fabric plies. This had no significant effect on the panel properties. It was already known that a skewness of 20° will give a substantially lower strength, but normal attention to workmanship should keep this from being a critical variable.

RESIN AND PREPREG HANDLING. A fabricator must maintain a stock of molding materials, yet thermosetting resins change upon aging through loss of volatiles and polymerization during storage. Most suppliers specify the maximum time their products can be stored. With liquid resins, which are stored uncatalyzed, age has relatively little effect. Prepregs, on the other hand, are catalyzed when the fabricator receives them. Hence, the storage life is lower.

Differences in concentrations of catalyst and/or curing agent affect the type and degree of chemical polymerization. In the preimpregnated materials, this variable is controlled by the material supplier; a molder has control only on the liquid resins. Paraplex P-43 catalyzed with benzoyl peroxide was investigated for the effect of catalyst concentration. In both press- and vacuum-bag molding, there was no effect within the range of 0.5-2.0%. In parallel strand molding, 0.5% gave slightly lower strengths than 1.0%. Tertiary butyl perbenzoate concentration was an important factor with Vibrin 136A—0.17% had less tendency to blister, but the 0.20% concentration gave indications of better properties.

Several curing agents and their concentrations were studied with Epons 828 and 1031. Because these agents are co-reactive with the resins, their studies were based on stoichiometric quantities. The proper amounts were different for each curing agent, molding method, and test property. A catalyst (BF_3 MEA) was also studied with Epon 1031, and the same situation held. The effects of activator concentration on epoxy resin systems cannot be predicted and must be determined by the particular application of the part.

CONTAMINATION. The presence of 1% water in Paraplex P-43 had no significant influence on the laminate or cured resin properties. Likewise, 1% acetone in the resin had no significant effect, but 2-3% acetone progressively reduced resin hardness and laminate flexural strength so that at the 3 per cent concentration, the flexural strength was significantly, but not seriously, reduced.

Polymer grade styrene was compared to the rubber grade, because both are widely used as a reactive diluent for conventional polyesters. No difference was found, using parallel strand-molded bars as the criterion.

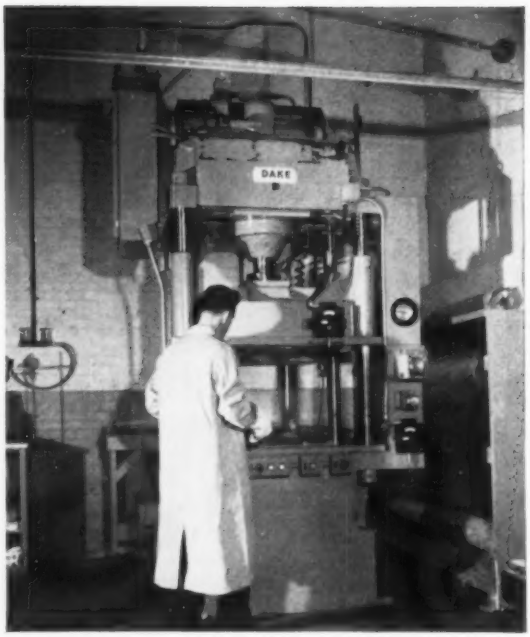

Fig. 5. Vacuum bag plus autoclave molding.

Conventional polyesters will absorb air in handling. In press molded panels, degassing the resin slightly raised the specific gravity. In vacuum bag molding, there was no effect. There was no effect on mechanical properties in either case. Cleanliness is essential with Vibrin 136A; dirt specks were observed to act as nuclei for blisters during postcure. Dirt can be removed by filtering the resin. Air and volatile impurities can be removed by degassing under vacuum. This was found to be a necessary and critical step. The vacuum, to be effective, had to have an absolute pressure of less than 1 mm. of mercury, and was most effective when the resin was heated to reduce its viscosity.

Epon 828/CL resin was studied in the vacuum bag molding process for the effect of degassing to remove air. Panel properties were not affected. Two grades of CL hardening agent for Epon 828 were also compared —S-technical grade and technical grade. They showed no difference in their effect on properties.

IMPREGNATION. Press molding generally gives a minimum of impregnation variation because the pressures and the resin flow usually assure good impregnation. With Conolon 506 preimpregnated fabric, an ambient relative humidity of 80% during layup was compared to one of less than 50%. This was no significant difference in panel properties. Mechanical working of the prepreg layup before molding was studied and air bubbles, visible between plies, were worked out with a spatula. This also had no effect on performance of a flat panel, although with a part having a complicated shape, it may be necessary.

Vacuum bag molding involves low molding pressures; therefore, it relies on technique for good impregnation with wet layups, and for consolidation with dry layups. Mechanical working of the wet layup had a critically important effect with the liquid resins, and improved

practically all properties. The importance of 60-80% relative humidity in the vacuum bag molding of Paraplex P-43 was studied, and found to have no effect on properties. Literature, however, cites that relative humidity in the 90% range has a deleterious effect.

With both the Conolon 506 and CTL 91-LD phenolic preimpregnated fabrics, studies were made of preheating the material under vacuum. In neither case was there any effect on laminate strengths. With parallel-strand bar molding, preheating the mold had no effect on properties with preimpregnated yarn and roving. With a liquid resin (Vibrin 136A), varying the resin bath temperature did not change the strengths. However, prewarming the mold when using the Vibrin 136A improved hot properties of the molding.

Molding Pressure. In press molding, thickness control is most easily achieved by the use of stops. An alternate method is closely controlled pressure. The effect of stops was investigated with several resins and a decrease in strength was observed in almost every case. A mathematical analysis of covariance showed this to be associated with reduced glass content. This can be overcome partially by making sure that stop thickness is an exact multiple of fabric thickness. However, the normal variation in fabric thickness makes complete solution of this problem unlikely.

Molding pressure was an important variable with high pressure resins. The slight variation in pressure possible in vacuum bag molding was never significant. Generally, pressure acts through the same mechanism as stops. Higher pressures increase the glass content and the properties of the laminates are increased. Flexural strengths seem to be most dependent on glass content increases, but compressive strengths of laminates were relatively unaffected either by the use of stops or by changes in molding pressure.

Panel Size. This variable was not studied directly. However, with two of the resin systems, CTL 91-LD and Vibrin 136A, difficulties were encountered in large (18 by 18 inch) panels which were not found in smaller panels (9 by 9 inch). With 91-LD, it was difficult to make good, large panels by the vacuum bag molding method. However, there was no problem with smaller panels. Vibrin 136A, which was troublesome during postcure, had a tendency to blister in large panels. This problem was not so severe in smaller panels.

Handling During Cure and Postcure. Two types of mold release film were compared in the press molding of Conolon 506—cellophane and polyvinyl alcohol. They had no effect on the laminate properties, but the PVA film could not be removed from the cured panel.

The same system was used, removing the panel from the press while hot and allowing it to cool in the press. This had no effect on any properties. In both press-and autoclave molding of Epon 1031, the cooling rates were studied. A water quench gave slightly higher hot compressive strengths than air. The vacuum bag-molded Paraplex P-43 panels were postcured, and the rate of cooling after postcure was investigated. The difference between cooling in air, and cooling in the postcure oven had no effect on the properties.

Most postcure investigations revolved around Vibrin 136A panels, since it was found that postcuring was the critical phase of their processing. Removal of resin flash after molding and a short time lag between cure and postcure reduced the tendency to blister. Wrapping the panel in aluminum foil, or variations in the cooling rate after postcure (to reduce oxidation) had no particular effect.

Cure Cycles

The relationship between molding time and temperature is most important for proper use of the resin. It determines the degree and type of polymerization through control of side reactions.

Paraplex P-43. In press molding with heated platens (240° F.), curing time had a definite effect on strengths. If the panel was removed just as the exotherm began, the cure continued outside the press and good properties were achieved. Platens take away exothermic heat. If the panel was removed just after the exotherm, the cure was incomplete and strengths were reduced. Two studies of cure cycles in vacuum bag-molding were made. These involved considerably longer times than did the press molding studies, because the panels usually took at least 30 minutes to reach 200° F., and in most cases did not reach the stated oven temperature. This is important, because it illustrates the slow rate of heat build-up in the panels. The vacuum bag-molded panels generally showed higher strengths than did the press molded panels, probably due to the slower cure. Cure cycle variations in the two vacuum bag-molding studies had only minor effects on panel properties. In general, oven temperatures of 200-325° F., and times from 1 to 3 hours all gave good-strength laminates.

Dryply. This material is analogous to Paraplex P-43 in that it employs a "conventional" polyester resin. However, its resinous component is not the same. Studies of cure cycles were made using both press- and vacuum bag-molding. The same temperature ranges were studied, although the times were different because of different methods of heating.

The rate of heat input is important with Dryply, but even more important is the actual temperature to which the panel is subjected. With both molding methods, the 225° F. cure was substantially superior to the 275° F. cure for practically all properties. The cure times had no significant effect. They were 15 minutes vs. 25 minutes for press molding, and 30 minutes vs. 40 minutes for vacuum bag molding. In press molding, the use of a short postcure increased flexural properties. In vacuum bag molding, all panels were postcured.

Vibrin 136A. This resin proved particularly sensitive to postcure, which actually caused a different type of polymerization from that of the primary cure. There were indications that a primary cure temperature of 230° F. was superior to one of 250° F. In press molding, a 4-hour cure time showed a slight superiority to two hours. These effects are based primarily on reduction of blistering in the panel. With parallel-strand molding, cure times of 3 vs. 4 hours at 230° F. had no effect on strengths. The postcure proved critical at 480° F. Apparently, there is a polymerization exotherm at this point which can cause blistering. This tendency to blister was greatly reduced by very close control of the oven temperature during postcure.

Epon 828. Because curing agents for epoxies are

co-reactive, the type of curing agent has a profound effect on the resin's processing requirements. All varying of cure cycles with this resin was done using CL curing agent. In press molding, changing the cure temperature from 200° F. to 250° F. had no effect, but increasing the time from ½ to 1 hour improved the strength at 300° F. The use of a postcure also raised the 300° F. properties. A similar situation existed in vacuum bag molding. Going from a 170° F. to 230° F. cure improved only the tensile properties, but extending the time from 1 to 2 hours improved all the flexural characteristics as well. A postcure also raised the 300° F. properties.

In the parallel-strand molding system, the cure cycle had no effect on properties. The temperatures covered were 210° F. and 250° F.; the times were 45 to 75 minutes. All moldings were postcured for 2 hours at 350° F.

EPON 1031. Most of the work was done with press molding and several curing agent systems were employed. In all work, BF_3MEA catalyst was used—at times together with DDS. When a postcure of 3 hours at 300° F. was used, in the case of BF_3MEA with DDS, the 500° F. flexural strength was the only property affected by cure temperature; 340° F. was slightly better than 310° F. Cure time (½ vs. 1 hour) had no effect. Using BF_3MEA alone, the higher cure temperature was somewhat better, but the cure cycles were constant (60 minutes at 300° F.), and the postcure varied. Here, the longer, lower postcure gave improved 500° F. properties (24 hours at 300° F. vs. 8 hours at 400° F.).

Vacuum bag molding work was not very successful with this resin because of warping and delamination. A curing temperature of 350° F. appeared to be more satisfactory than 310° F., and the 3-hour cure seemed slightly better than the 2-hour cure.

CONOLON 506. Two press molding studies were made. In the first, the time (45 vs. 90 minutes) had no effect on properties, but the temperature did. The use of a postcure of 25 hours at 450° F. with 3 hours' heatup time had no effect. In the second, the cure time was constant at 1½ hours; there was no postcure. There was a strong interaction between molding pressure and temperature. Best molding temperatures for the three following levels of pressure are: 16 psi., 325° F.; 20 psi., 365° F.; and 40 psi., 375° F.

In vacuum bag molding at 350° F., changing the cure time from 1½ to 2 hours had no effect on the properties. The effect of postcure schedule was small, but 350° F. postcure gave better hot tensile strengths than the 500° F. postcure. The autoclave molding study was not entirely successful, because it was not possible to make good panels with the lower cure conditions of 300° F. for 60 minutes with postcure. In parallel strand molding, cure times of 45 and 60 minutes at temperatures of 310° F. and 350° F. had no effect on the properties of the molding.

CTL 91-LD. In press molding this material, the cure time and temperature differences had little effect on properties, but the postcure schedules were important. Cure conditions of 15 to 20 minutes at 270° F. and 300° F. had no effect on laminate properties. This indicates that the primary cure of CL 91-LD does not require precise control. Postcure times of 15 and 24 hours at 300° F. affected only the hot compressive strength with 24 hours being better. In order to obtain a laminate that would maintain strength after 192 hours at 500° F. it was necessary to go to a much longer postcure. This required 24 hours at each of the following temperatures: 250, 300, 350, and 400° F.

In vacuum bag molding, two types of prepreg were used—low flow and high flow. The cure schedules were similar, both being at 350° F., but the heatup rates were different. Two postcures were used: stepping up to 350° F. in 48 hours, and stepping to 450° F. in 102 hours. The slower heating was better with the high flow material, and the faster heating was better with the low flow material. For the basic properties, both types of materials were slightly worsened by the more severe postcure; the low flow material suffering most. For long-term strength at 500° F., the longer postcure was necessary.

DC 2106. Two similar investigations of press molding were made with varying cure times, temperatures, and postcure cycles. The effects found were minor. Changing the cure time from 60 to 90 minutes had no effect, and there was no difference in strength caused by changing the postcure. The postcures used were stepped from 195° F. to 480° F., the difference being in the amount of time at the lower temperature. Changing the curing temperature from 330° F. to 365° F. had a minor effect in only one of the studies, where the higher temperature gave a slightly lower flexural strength and a slightly higher flexural modulus.

In vacuum bag molding, the times studies were 2 and 3 hours, the temperatures were 325° and 350° F., and a long and short postcure were used. At the cure temperature of 325° F., the longer cure time and longer postcure schedule were superior. At the 350° F. cure temperature the reverse holds true—the shorter cure time and the shorter postcure gave better results.

Tests and Controls

Adequacy of Existing Methods

In process control testing of the basic materials, most methods in current use fulfill their requirements. As examples: specific gravity of glass, yarn construction, and specification of 225-3/2 are satisfactory in the wrap of 143 style (4-harness satin) fabric. Viscosity, reactivity, acid number, and weight per epoxide are all reliable determinations useful in establishing a chemical definition of a resin.

Unfortunately, the closer the materials approach the molding process, the less reliable are the tests and controls. A fabric finisher must rely heavily on process control and laminate testing to maintain the quality of his finished fabric. Chrome content analysis will disclose errors in the amount of chrome coupling agent applied, but will not disclose whether or not it was properly cured or set. The Bromine Number determination for silanes will give an indication of the relative quantity of reactive elements available in the finish, but this test procedure demands precision facilities and, inherently, is not highly reproducible. A dye color test for finish quantity is easily performed, but it does not determine

the efficacy of the finish application nor is it a precise quantitative test. As a result, the finisher finds himself in the position of being required to make test panels in order to obtain an authoritative quality description.

In the production of finished parts or test panels, the molder has a number of process factors which he must keep under control at all times. Many of these factors are quite easy to deal with. Pressure measurement and control fall in this classification. Catalyst concentration used in the resin would appear to be an uncomplicated matter of weighing and mixing. These, and many others are just what they seem. However, the existence of interactions between various process factors makes the estimate of their effective values more complex.

This obscurement of significance can be exemplified by a consideration of cure conditions, which are normally considered to be represented and controlled by the time at a given temperature. Time control is a simple task, and precise temperature maintenance is a routine matter with accurate oven, platen, or mold instrumentation. The important factor is rate of heat input.

The three methods of test panel preparation, shown in the accompanying photographs, can all be used to supply the proper heat for the cure of reinforced plastics. These methods all supply different rates of heat input; therefore, time of molding must be varied for optimum properties in the cured panel.

Instead of specifying the time and temperature of cure, the cycle should be stated as a function of total heat added to or taken from the laminate. This can be done by temperature vs. time curves, but it requires relatively complex instrumentation.

The Fabricator's Dilemma

The molder's process and quality control data cannot be interpreted directly in terms of end use performance; therefore, like the materials suppliers, he must make test panels. Usually, he has to supply several prototypes and/or production models of the molding for actual, accelerated, or simulated "service tests."

The major weakness in quantitative evaluation of the performance of glass-reinforced plastics lies in the following set of limitations: mechanical strengths and physical properties which must be determined by standardized destructive techniques; techniques which can be performed reliably only on specimens that are relatively small, uniform in cross section, and flat; and test panels which seldom duplicate physically, thermo-dynamically, or mechanically the "production" of the part itself.

Consider a fabric finisher, who must monitor his process by determining the strength of glass-resin laminates made from material treated under conditions, wherein the specifications bear little direct relation to the final application. The resin manufacturer observes his product's performance by combining it with factors—the qualities of which are outside of his control.

This approach can be both justified and challenged. Justification is found in its use for strictly comparative purposes, wherein conditions can be standardized. The objection arises when, for example, a resin might have superlative properties with a specific combination of fabric finish and molding conditions but, under the "standardized" conditions, could be handicapped.

Destructive testing of production items, either a coupon cut from the part, or using simulated-life test, can be a very worthwhile approach. However, care must be exercized in interpreting results. This is usually a costly way of controlling end product quality but, in general, it is more reliable than tests from separate flat laminates.

Nondestructive Testing

Nondestructive testing, which is in the early stages of development, can be considered seriously as the best approach toward assuring that molded parts are of the highest quality. The work done to date indicates that it has the potential of supplanting destructive testing for end product quality control. However, its present use is limited to a few specific items, and much work on perfecting existing approaches must be done before it can be exploited efficiently.

Acknowledgments

The assistance given to the authors in this work was too great to allow acknowledgments to individuals. Members of the reinforced plastics, chemistry, textile, and testing laboratories of Owens-Corning Fiberglas Corporation contributed valuable help in all phases of the work. Other companies and individuals assisting in studies of resin variables are personnel of Rohm & Haas Company, Naugatuck Chemical, Shell Chemical Corp., U. S. Polymeric Chemicals, Inc., Cincinnati Testing & Research Lab., Inc., Narmco, Inc., and Dow Corning.

Valuable assistance was received from Raytheon Manufacturing Co. in electrical property determinations. Brown University programmed their computer for use in data analysis. Mr. Cuthbert Daniel was consultant for the design and analysis experiments. The chemical engineering section, materials processing branch, manufacturing methods division of the AMC Aeronautical Systems Center, and the plastics products section, organic materials branch, materials laboratory of the Wright Air Development Center gave valuable direction and advice in the performance of this project. —The End

Coming in December Issue

The December issue will feature a special study on "Markets for Flexible Plastics Foams," by marketing consultant P. B. Nortman, Leonia, N. J. This report deals with urethane, vinyl, and latex foams, and studies their market development during the past decade, their current status, and their outlook for the future, both individually and comparatively.

P. Bernard Nortman is a native New Yorker, receiving a B.B.S. in 1934 from C. C. N. Y., and a M.A. in 1935 and Ph.D. in 1938 from Columbia University. From 1938-1942, he was an Economist for the U. S. Government, and was a Marketing Consultant from 1948-1953. He served as Economist for Lever Brothers from 1953-1954, then as General Manager of Marketing for Pathecolor, Inc., from 1954-1957. From 1958-1960, he was Director of Market Research for Seaboard & Western Railroad. At present, he is a free-lance marketing consultant. —The End

Hows and whys of plastic tooling

Proper use of fillers assures large epoxy tools of predictable tolerances

F. L. BOGART*

Plastic tooling resins can be modified by the addition of fillers, thus allowing fabrication of large tools within predetermined tolerances. To understand the behavior of tooling resins, we must understand the effects of cure on the base resins. Since more than 90% of plastic tooling is now based on epoxies, we will consider this type of resin only. Unfilled epoxies shrink more than 4% in volume during cure; therefore, fillers are used to lower this figure for tooling applications.

Cure cycles

An ideal cure cycle for an epoxy resin is one which will yield the best physical properties, cure rapidly to a relatively stable condition without gassing or entrapped strains, and shrink from mold dimensions within tolerances. Too fast a cure cycle will cause undue shrinkage and relative instability through entrapped strains. On the other hand, too slow a cure cycle delays stability—often beyond the time the tool is supported by the mold. This causes warpage and distortion. A slow cycle often allows the resin to acquire moisture unless specially formulated. This results in an incomplete cure, low stability, and poor physical properties.

Figure 1 shows a typical setting curve for a standard laminating resin; Figure 2, a typical curve for face casting resins; and Figure 3, a curve typical for a mass casting resin. These three charts indicate the relative cure cycle for 200 grams of resin plus hardener. Their cure cycles may be modified in fabrication by addition of other fillers such as glass cloth or granular material.

Larger masses of material show a faster rise in temperature because of the greater amount of energy released. Peak exotherm is also affected directly by mass, since radiation is restricted by surrounding material. There is a faster rate of cure due to increased temperature. Controlled reaction, therefore, is needed to provide complete cure within the desired temperature

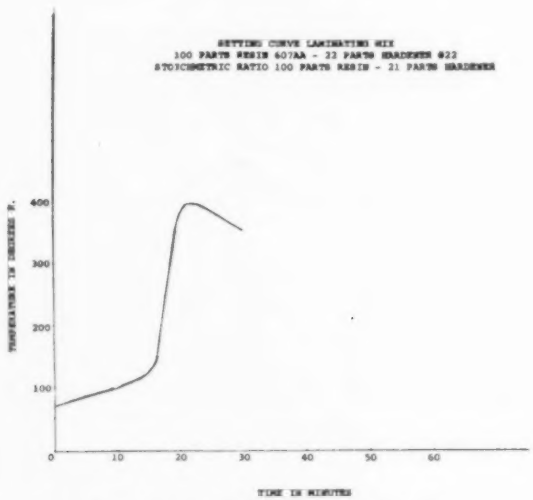

Fig. 1. Setting curve for a laminating resin.

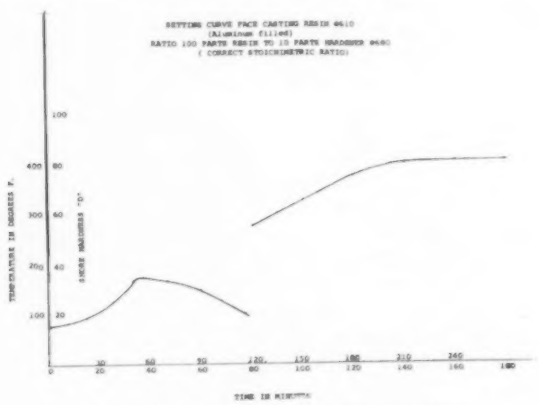

Fig. 2. Setting curve for face casting resins.

*Sales Eng., Marblette Corp., Long Island City, N. Y.

limits. If the initial reaction begins too slowly, added heat (within the maximum temperature limits) will not provide enough energy to complete the cure within normal time limits for tooling. Too, the addition of heat may be ruled out for its effects on the mold.

Castings

A cast which is poured ¼-inch thick (mass casting formulation) can, if the resin and the room are cold, remain rubbery and uncured for days. Heat added after 16-24 hours still may leave an additional 24 hours or more before the casting is sufficiently hard to part from the mold. Hardness usually indicates the degree of cure and, thereby, the degree of ultimate strength. For this reason, a hardness tester such as the Barcol or Shore "D" is an asset to the tool maker and inspector.

A face casting resin, poured several inches thick on a hot day and in an insulated mold, will probably react in an uncontrolled way. Even if boiling does not occur, as a result of the maximum exothermic temperature's exceeding the volatile point, expansion will be excessive. After solidifying at this temperature, the thermal shrinkage (on cooling) may be several times polymerization shrink and normal thermal shrink. Shrinkage of a face casting resin, poured ¼-inch thick in a core, can be so small as to be unmeasurable due to the core support. Small casts 2- by 2- by ¼-inch can show no more than 0.0002-inch per inch when poured in cavities.

Long, mass castings can be filled with up to four parts granular material—such as No. 0 granite chip—and show even less shrink. This is due to the supporting action of the core mix. In these casts, the total shrink of the epoxy system takes place—but, at a slower rate. Considerable "slumping-down" into the mold has taken place while the plastic is still fluid. It is this factor which makes epoxies so adaptable to tooling, since as much as 80% of the shrink occurs while the mix is still fluid. Maximum use of filler reduces physical properties; therefore, the amount used depends on tool requirements.

It must be noted that pouring risers, which provide a head, should be narrowed down where they gate to the mold. Unlike metals, epoxies solidify first in the area of most material. This is, therefore, the first area

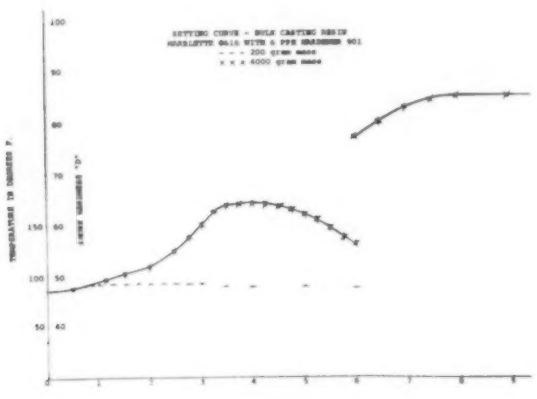

Fig. 3. Mass casting resin curve.

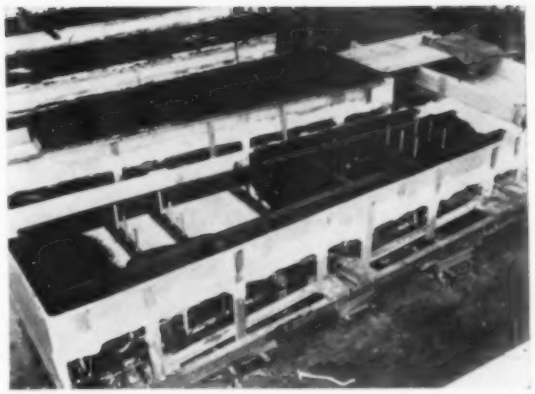

Fig. 4. Maraset epoxy resin #616 and rock aggregate used to cast large stretch dies.

to shrink and the area of greatest shrinkage. If a large mass is in the head just over a thin part of the casting, this thin area can actually shrink back into the head.

Filler type and addition

Addition of fillers to plastic tooling resins not only reduces shrinkage, but lowers costs and provides special properties. Powdered fillers are milled carefully into the resin by formulators to provide certain properties. In the case of laminating resins, 5-10% filler addition provides opaqueness. Fillers can improve such handling properties as brushing. However, if improperly selected, the filler can absorb moisture, settle, or cause any number of embarrassing problems.

Face casting resins combined with filler provide

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Fig. 5. Metal fibers sprayed alternately with epoxy gives fast tool build-up.

Guest editorial

Polyolefins—recent developments of italian chemical industry

DR. PIERO GIUSTINIANI*

No previous generation has had the privilege of witnessing such rapid development in all technical and industrial fields as has ours.

Many of us, especially those of my age, still recall the organic chemical industry as it existed prior to the first World War. Actual organic syntheses were then confined to products of specific value, such as dyes, pharmaceuticals, a few acids, and solvents. Immediately thereafter selective catalytic processes made their appearance, which allowed the utilization of such low-cost raw materials as carbon monoxide, hydrogen, and nitrogen to obtain consumer products.

At about the same time, a field of enormous practical importance emerged; namely, the production of macromolecular compounds. These have made a great impression in the plastics field. Synthetic products, which were discovered over an extended period, retained the term "substitute," however, for too long a time. Only today, are they being evaluated on the basis of their own design properties.

At first, synthetic polymers and copolymers obtained by normal processes were simply mixtures of isomers and stereoisomers incapable of crystallization. Their mechanical properties were only partially satisfactory because their synthesis made it difficult to obtain products of uniform stereoisomerism. Until recently, of all the olefin polymers, only polyethylene (first obtained by I.C.I. under very high pressure) was partially crystallizable— and even it does not have a very high crystallinity since its macromolecules are not linear.

Despite the important results subsequently achieved by E. I. du Pont de Nemours, by Professor Ziegler, and by Phillips in the field of highly crystalline polyethylenes, the problem of the truly stereo-selective synthetic processes still remained unsolved. Synthetic high polymers, the monomers of which appeared attractive due to their great availability and low cost, were viscous, pitchlike substances without practical interest.

In 1952, Professor Natta spoke to me about his work and the work of Professor Ziegler. A mutually satisfactory agreement was reached with the German scientist in 1953. On this basis, Montecatini became one of the first licensees in the pioneer development of organo-metallic catalysts. Later, in December of 1953, our Company (still according to the same agreement) was able to use the new Ziegler catalysts for the production of ethylene high polymers.

Since that time, Professor Natta and his associates at the Polytechnic Institute of Milan, together with a large staff of chemists of the Ferrara, Terni and Novara research laboratories of the Montecatini Co., have intensified their studies in this field. Their work has come to an outstanding conclusion which permitted Italy and the entire world to enjoy catalytic processes which are at last truly stereoselective.

These stereospecific processes greatly increased the number of high melting-point crystalline polymers with excellent mechanical characteristics. Furthermore, it is now possible to produce (by stereoselective processes) linear polymers of regular steric structure from monemers containing oxygen, chlorine, and nitrogen.

The crystalline polymers obtained from alphaolefins generally consist of long, linear macromolecules with a configuration of the tertiary carbon atoms that Natta has called "isotactic" structure. The definitions given by him are today well-established terms throughout the world.

Most important of today's isotactic polymers is polypropylene, first produced in the plants of the Montecatini Group and trade named Moplen. The first hy-

* Managing Director, Montecatini Company

drocarbon—derived thermoplastic to withstand 212° F., it has a very interesting application in extruded film and sheet. Polypropylene film—Moplefan, as it is called by us, is quite transparent in thin gages. The properties of bi-axially oriented polypropylene film are clearly superior to those of similar films.

Another important use of isotactic polypropylene is in the melt spinning of synthetic fibers. They are presently produced in the Terni plant of the Societa Polymer of the Montecatini Group under the trade name Meraklon. These polypropylene fibers have special and outstanding textile properties alone or in combination with wool, cotton, viscose, and other fibers.

By applying the stereospecific polymerization processes to diolefins, it is possible to obtain from butadiene, elastomeric products having excellent properties. The vulcanizates of Cis 1,4 polybutadiene, for instance, have elastic properties comparable to those of natural rubber, plus an extremely low brittle temperature. It can be said today, that with pure Cis 1,4 polybutadiene, the problem of low hysteresis rubbers with satisfactory mechanical properties has been solved.

All these new polymerization processes are giving surprising results in the copolymerization of alphaolefins as well. The ethylene-propylene and ethylene-butylene copolymers have elastomeric properties very close to those of natural rubber and superior to those of the more common synthetic rubbers. These copolymers are practically free of double bonds and, therefore, have the constituency and properties of a saturated hydrocarbon. Special vulcanization formulations have been studied, which allow copolymers to be obtained directly from mixtures of monomers at a low processing cost.

The first commercial installation in the world for producing these copolymers will operate at Brindisi, where initially 20,000 tons per year of ethylene-propylene and ethylene-butylene copolymers will be produced. Plans for doubling this capacity are now underway.

In most countries, and particularly in Europe, patents covering the Montecatini-Natta processes and products have either already been issued or are in the process of being issued. In the U.S.A., five years after the filing of the first patent, the situation is still unsettled due to the special patenting procedure of that country.

For non-residents of the U.S.A., and such we are under present practice, the priority of invention is established by the priority date of the application filed. But American residents can "swear back" from their filing date, which means produce documents, such as laboratory notebooks and the like, to prove that the foreign invention was preceded by American conception.

It is our opinion that the intellectual property rights of scientists and research workers should be scrupulously respected, and that the inventor should not be deprived of the results of his invention even if, by chance, special aspects of the law make it possible to initiate certain actions with apparent legality.

It is also our opinion that against infringements of any kind, no matter by whom, it is necessary to act with firmness in order to retain, in this field, the honesty and dignity legitimately owed to science and technology. And, to facilitate success of the action, it is necessary to be cautious with regard to disclosures, until the patent situation has been completely clarified.

It is with pride and satisfaction, as technical people, that we state ever more strongly our ability to meet the vital necessities of mankind. We can make available items of mass production with equipment which is more and more efficient, using raw materials which, at least at the present time, appear to be in unlimited supply.

—The End

Hows and whys of plastic tooling

(Continued from page 49)

lower shrink, high impact resistance, and/or abrasion resistance. Though basic costs are lower, you cannot count on saving money through filler addition. Research and quality control testing are needed to ensure an acceptable tool, which may cost 10-20 times the price of resin used.

Bulk resin formulations can utilize fillers to control exotherm over a wide range of sizes and conditions. Addition of granular fillers will reduce shrinkage and maximum exotherm temperature. Large casts, many thousands of pounds in weight, can then be cast accurately and not distort the mold by excess exotherm (See Fig. 4).

Spraying metal fibers to provide interface bonds between the epoxy and other plastic or plaster backing is rapidly becoming accepted. This technique can "build-up" tools inexpensively. It shows promise in foundry applications, and where speed and low costs are essential. The fibers act as a filler, but also interlock to provide added strength and other properties—particularly ease of machining (See Fig. 5).

In laminating formulations, glass is used as the filler. It reduces shrink and maximum exotherm temperature, while providing highest physical properties through its great strength. Because glass cloth consists of oriented and continuous fibers, its strength does not reduce the bond strength of the plastic in two dimensions. Glass fibers, being stronger than the resin, cause almost all shrinkage to occur through the thickness, or normal to the weave. This gives dimensional stability in two dimensions.

When glass is cleaned and finished chemically, laminate strength is improved through better bonding. This is particularly in evidence when stresses are applied normal to the glass weave, a factor which tends to bring about delamination or separation of the glass cloth layers.

Proper fabrication of laminate tools requires support of the material until over 94% cure is accomplished. The automotive industry, in eliminating problem tools, has drawn up tight material and process specifications to assure accurate and stable tooling. Once properly set, laminates should be as stable and accurate as normalized metal tools. Cast tools will show excellent stability and accuracy, if allowance is made for their higher thermal coefficient.

—The End

Economics and limitations of blow molding

Economy is not determined by the number of molds

VERNON HILL*

Many questions are being asked about blow molding, but probably the most vexing one is, "What type of equipment is best suited to what type and level of operation?"

There is no easy answer and no one determining factor. In order to assess the economic operation of various equipment, it is necessary to select a single product item and use this as the base means to compare such factors as prime cost of equipment, number and cost of molds, output, labor required, return expectancy on capital, etc.

A cost per 1,000 items should be determined and then re-examined in relation to the total cost for producing at different levels of production, allowing for initial set-up costs and mold amortization over the length of run.

Economics

It should be realized that blow molding is now an integral part of the plastics industry the same as such other major process techniques as injection molding, extrusion, compression, or vacuum forming. It then becomes obvious that any machine, per se, is only the beginning and not the entity itself.

Any blow molding machine has a means for clamping a mold, a parison in blowable condition, and a means to introduce and control the blowing air. The size and versatility of the equipment will be dictated by the average range of products to be produced. Economy of production for several machines, each capable of producing the same part, can be assessed by a dollar and cent analysis which is reduced to a cost per thousand parts.

Table 1 shows the comparative economics of commercially available equipment. The method of setting up this comparison was done deliberately to isolate the picture solely in relation to differences in equipment. No consideration was given here to mold amortization in relation to length of run, set-up costs per run, product development cost, plant overhead, corporate overhead, building costs, capital goods taxes, packing costs, shipping costs, selling costs, or return on additional fixed and working capital.

All but the first two factors given above cannot be assessed in a paper of this nature, owing to wide variance in operating set-up. However, a further analysis is made in Table 2, where these two factors have been added to the final cost per 1,000 shown in Figure 1, and are expressed in terms of total cost required to produce at various quantity levels. From this, it can be seen that different types of equipment are economical only at certain levels of production.

For production quantities of 100,000, the single mold machine (either of the rising or sliding mold type) is the most economical. Between 100,000 and 1,000,000, a 4-mold cross-manifold machine takes the lead position in minimum production costs. A 6-mold rotary machine does not really become economical until the run is over 5,000,000 parts of the same item—produced in one continuous run from the initial set-up.

Further, it should be realized that in a multi-mold rotary machine, or multi-mold injection transfer arrangement, each mold in the set-up must be for the same part. In employing the same number of molds in single-mold machines, or in a multi-mold cross manifold machine, a different part can be produced—within limits—from each mold in the one set-up.

Limitations and Conclusions

By employing a large number of molds in any one machine, a very high output can be claimed in relation to labor employment; but, the use of such a machine will only be economical if astronomically high production of a single item is required.

A machine employing 72 molds was once built in Europe, and quickly abandoned when it was finally

* Market Development, formerly with Auto-Blow Corp., now with Enjay Co., Inc., New York, N. Y.

Table 1. Comparison of Costs to Produce Same Item (2-Ounce) on the Following Commercial Machines

		Cross Manifold				Injection-Transfer 6 Blow Molds,	
	Rotary, 6-Mold	A-2 Mold	B-2 Mold	C-4 Mold	D-2 Mold	3 Parison	Rising Mold (1)
Production, Rate/hr.	720	300	300	600	240	500	270
Cost, Machine & Extruder, $	32,000	23,000	20,000	36,000	17,000	29,000†	17,800
Cost, Finishing Equipment, $††	10,000	4,000	4,000	8,000	4,000	—	4,000
Equipment Cost, $/1,000*	1.17	1.90	1.60	1.42	1.75	1.16	1.61
Labor, per Machine**	1.33	1.50	1.33	1.25	1.50	0.5	1.50
Labor, $/1,000#	3.70	10.00	10.00	4.17	12.50	2.00	11.11
Total Cost, Labor & Equip./1,000	4.87	12.00	11.94	5.67	14.25	3.16	12.42
Expected $ Return on Capital##	0.42	0.88	0.82	0.49	0.97	0.23	0.80
Total Cost per 1,000 Items	5.29	12.88	12.76	6.16	15.22	3.44	13.52

* Based on 10-year amortization & 5,000 hours operation per year.
** Machine operation plus finishing labor plus service labor.
\# Based on $2.00 per hour, no fringe or insurance.
\#\# Based on 20% annual return before taxes on machine capital & 3 months labor.
† Includes injection machine instead of extruder.
†† Finishing equipment is shown in each case other than injection molding, since compression molded necks with flash on thread are unacceptable to many volume users.

Table 2. Total Cost in Dollars to Produce at Various Quantity Levels

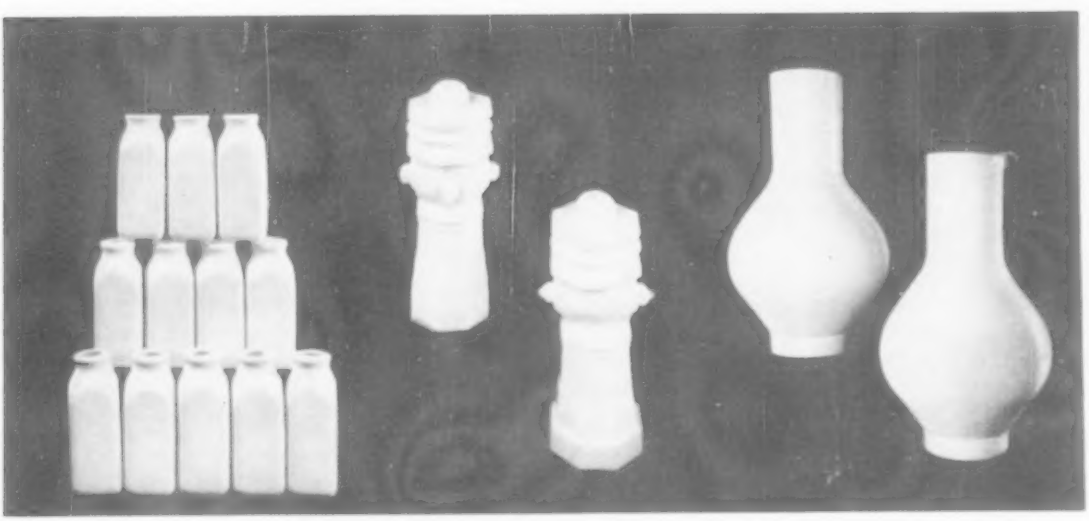
		Cross Manifold					
	Rotary	A	B	C	D	Injection-Transfer	Rising Mold
10,000 parts	4,872	1,750	1,741	3,283	1,765	8,469	1,145
50,000 parts	5,084	2,300	2,252	3,630	2,375	8,607	1,686
100,000 parts	5,349	3,000	2,890	3,838	3,136	8,918	2,362
1,000,000 parts	10,110	15,494	14,374	9,382	16,834	11,865	14,530
5,000,000 parts	31,270	66,014	65,414	34,022	77,714	25,735	68,610

Figures are based on cost per thousand, from Table 1, plus initial set-up costs and mold costs in terms of total cost per quantity. Set-up time in man hours: extruder, 3; die heads, 1; and molds, 1. Molds were charged at $1,000 per single mold, $800 for additional molds, and $200 for the blow sticks used with the injection-transfer type machine.

realized that it needed runs of 100,000,000 to compete economically with other equipment of far less capital cost and employing many fewer molds. Even at this production level, such a machine in operation in the United States would turn in a $6.00 per 1,000 cost.

The limitations of blow-molding are set by the cooling time of the material in the mold, the size and weight of the part, and the length of run that can be obtained.

—THE END



Typical blow molded items by Chanal Plastics Corporation.

Reinforced plastics

"Reinforced plastic boat manufacturers: beware!"

Edited by: HARRY T. DOUGLAS*

Many reinforced plastic molders have turned eager eyes toward the bright growing future in small-boat manufacturing. In the past year, the industry has seen a shake-up in the small-boat field, but this is a temporary reshuffling where many small outfits who couldn't carry on closed their operations and large producers remained stronger than ever in the field. Therefore, such minor business failures have not dampened the spirits of fiber-glass boat manufacturers, and we can expect to see many of them expanding, with new ones popping into existence like toadstools after the rain.

Boating has become a national recreational pursuit. People are buying a boat instead of a second car. Youngsters are operating boats in ever-increasing numbers. Marinas are cropping up all over America. New York City is anticipating the construction of several large marinas around its harbor.

To the reinforced-plastics molder entering the fiber-glass boat field, or to one who has been around awhile, there are many problems unresolved in this otherwise happy scene. These problems are new to the reinforced-plastic boat manufacturer because he is new to the business, whereas boat manufacturers building boats from other materials have weathered many seasons and are better prepared.

In discussing the making and selling of fiber-glass boats with other molders, I believe that many of them are of the opinion that their responsibility is to make a good boat, and leave the selling of the boat to boat dealers. Many manufacturers, anxious to get their boat on the market in time, will take on anyone as a dealer. Service-station operators, fruit and vegetable-stand owners, hardware-supply stores, etc., have become "boat dealers" by propping a few boats against the side of a building. Dun & Bradstreet, in their new Boating Directory, list thousands of dealers among whom are restaurant owners, monument makers, greenhouse operators, etc. Everyone and his brother is trying to get into the act. This is reminiscent of the early days of fiber-glass molding when anyone who had a garage or a basement became a laminator.

There is skill required in being a good boat dealer, as in everything else. Although the market is growing it can grow bigger and better if qualified personnel are doing the selling job. We are just scratching the surface of boat sales. If such tremendous strides in boat sales have been possible with so many makeshift dealers, what untold sales potentials exist with competent, dedicated personnel? More boats surely could be sold if a longer look were taken of what constitutes a good boat dealer. There are a goodly number of reputable boat dealers, but here are some gripes about the others:

Too often they are undercapitalized. They spend their money on the early models, and have no cash left for additional purchases. They put a deposit down on the boats, and can't make good on the balance. These boat dealers are probably good mechanics, but often very poor salesmen. They are not promotion-minded. They don't bother to know the manufacturer's product. They make weak sales in-between fixing motors and selling gas. When a problem arises after the sale is made, the dealer points to the manufacturer and steps aside from all responsibility. They do not stand behind the product they sell. They place too much emphasis on trying to make money by selling accessories, instead of concentrating on selling a brand-name boat. History is replete with such examples.

When it comes to making boat repairs, they charge an arm and a leg to do it. They do not have a good "service" organization. They know very little about each boat and often are prejudiced against fiber-glass boats in general. Their paper work is slip-shod. They do not bother to read their mail for price changes or new data from the manufacturer. Very soon the public will demand a change.

In this type climate, what is the reinforced-plastic boat manufacturer to do? How can he evaluate the qualifications necessary in a boat dealer when he himself may be new in the business?

I don't believe a gas-station attendant can sell many cars with which he certainly has more than a nodding acquaintance. Therefore, why do boat manufacturers expect him to do well selling boats? Reinforced-plastics molders who are unaware of these problems should investigate the entire situation thoroughly before setting aside a plant area to the production of fiber-glass boats. They should check the boat dealer's past performances, not judge his present status. They should check the re-

* Executive Vice-President, Lunn Laminates, Inc., Huntington Station, New York

lationship which exists between him and other manufacturers on whether or not it has been satisfactory; and with other boat dealers to find out what they think of their colleague in the field. They should be critical of the manner in which other people's boats are displayed, how they are maintained, and what services are offered boat buyers.

The most practical setup from the manufacturer's standpoint is to sell boats through a chain store. The chain store would stand behind the product. Such outfits have money behind them and can buy in bulk all year round. They have better display facilities, better salesmen, better storage inventory space, and better service. They do not make such outlandish claims to get rid of a boat as a dealer might.

There, also, have been advocates of selling boats through car showrooms. They point out that advantages to this type of merchandising are many, including the fact that most showrooms are located in large cities and, therefore, accessible to larger audiences. The boats can be displayed all year round. If the prospect is interested in a trial run, arrangements can be made for an identical model at a nearby waterway.

Because not all boat dealers can evolve into chain outlets or city showrooms, many of the fringe element will have to improve their positions and their selling techniques rather drastically to keep from being elbowed out of the business. The dealer who is stingy with services suffers a loss of sales which affect the boat manufacturer directly. Many a manufacturer's death knell was rung by the dealers with whom he was signed up.

Fiber-glass laminators may be blessed with good boats in their plants, but the final test is in selecting a reputable, dependable, service-minded boat dealer, and only this will determine whether or not these good boats get sold and remain sold season after season. —THE END

Corrosion resistance of different polyesters

Tests at Atlas Powder Co., Wilmington, Del., have shown that wide differences exist in the corrosion resistance properties of polyester resins. In the tests, castings and laminates made from three polyester resins—bisphenol A, isophthalic, and general purpose—were immersed in eight corrosive aqueous solutions for periods ranging from 24 hours to 90 days and changes in physical properties were noted. The corrosive media included: distilled water, 5% sodium hydroxide, 5% nitric acid, 25% sulfuric acid, 15% hydrochloric acid, 25% acetic acid, Clorox, and 5% Electrosol, a commercial dishwashing detergent.

According to S. S. Feuer, development supervisor, chemicals division, one significant finding was the inapplicability of a fast screening technique as an index of corrosion resistance. In the screening trial, three castings were subjected to boiling sulfuric acid, distilled water, and sodium hydroxide for 24 hours. It was found that a resin might withstand the screening test, but not hold up after longer immersion periods. For example, isophthalic resin, which appeared satisfactory after a 24-hour boil in the sodium hydroxide, completely deteriorated before 30 days at 210° F.

After the 90-day exposure test, none of the bisphenol A samples were appreciably deteriorated, with the exception of the casting immersed in nitric acid. The general purpose polyester, however, was seriously affected by all of the corrosive media, and the isophthalic specimens, except for those immersed in sulfuric acid and Clorox, were seriously or completely deteriorated.

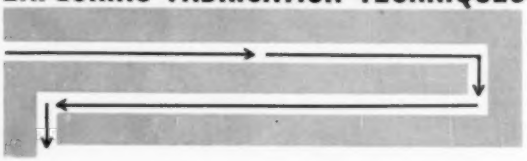
A 30-day immersion in Electrosol completely deteriorated both isophthalic and general purpose polyesters, while bisphenol A retained 50% of its original flexural strength after 90 days. Sodium hydroxide attacked both general purpose and isophthalic polyesters, and both lost almost all their flex strength before 30 days. Bisphenol A polyester retained almost 60% of its flexural strength even after three months of exposure.

PER CENT OF FLEXURAL STRENGTH RETENTION OF POLYESTER CASTINGS

		Dist. H_2O	25% H_2SO_4	5% NaOH	5% HNO_3	15% HCl	25% AcOH	5% Electrosol	Clorox
Screening Test Trial 24-Hour Boil	Bisphenol A	81	91	84					
	Isophthalic	74	108	106	← NOT TESTED →				
	Gen. Purp.	47	68	←14					
30-Day Immersion @ 210°F	Bisphenol A	56	66	71	66	59	74	76	70
	Isophthalic	29	72	Dissolved	41	32	19	42	89
	Gen. Purp.	←16	41	Dissolved	←12	←10	←9	←13	←15
90-Day Immersion @ 210°F	Bisphenol A	60	62	59	40	75	71	50	51
	Isophthalic	←18	73	Dissolved	←14	←20	←9	0	52
	Gen. Purp.	←13	Deteriorated	Dissolved	Deteriorated	← 7	← 7	Deteriorated	←14

PLASTICS TECHNOLOGY

EXPLORING FABRICATION TECHNIQUES



By L. J. ZUKOR, *ENGINEERING EDITOR*

Biaxially Oriented Film and Sheet*

Optimum properties at low cost—these are the features which make biaxially-oriented film and sheet so desirable as packaging materials. As films, these materials are opening up new markets in the overwrap field. Being stiffer than conventional thermoplastic films, they can be used on existing high-speed overwrap machines.

Treated plastic sheet seems to be better suited for pressure and vacuum forming operations than does its unoriented counterpart. DuPont's oriented polyester film, Mylar, was largely responsible for starting an industry—continuous plastic web metallizing. Now, other oriented plastic materials are available for metallizing.

Oriented film and sheet are the result of an added processing operation. Beginning with extruded, cast, and calendered thermoplastic resins, the films are worked mechanically and thermally.

When plastic films are made by conventional methods, the polymeric (long chain) molecules are randomly arranged along three axes; in the machine direction, in the transverse direction, and in the direction perpendicular to the surface of the web. The physical properties of conventional film are about equal in all directions, and are determined by the nature of the resin used. If, during the formation of a film, the gelled resin is subjected to a stress (pull), the molecules line up or become oriented in the direction of the applied stress (stretch). The extent to which these molecules are oriented has a very important bearing on the end-product properties. Tensile strength and initial tensile modulus increase as the molecules are oriented (tensile modulus is a measure of film stiffness—the higher the modulus, the greater the stiffness). Increased tensile properties can best be explained in this manner: long chain molecules, like fibers in thread, can be lined up in the direction of pull; each supporting a small portion of a heavy load. If, however, only a few are aligned in the direction of loading, they become overloaded and break under a significantly lighter load. When plastic webs are stretched in both the machine direction (M.D.↓) and the transverse direction (T.D.→), you get the above effect. The process of orientation is a critical one, depending on a proper amount of heat being applied to the web while it is beng stretched, and the length of time during which the temperature of the web is held constant. The latter requirement usually limits the machine speed.

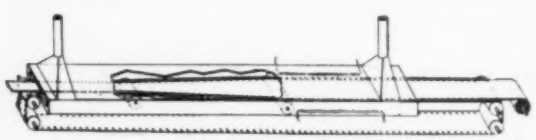


Diagram courtesy: E. I. DuPont de Nemours & Co.

Stenter-Frame Diagram.

The softening temperature of a thermoplastic resin is known as the second-order or glass transition temperature. Below this temperature, polymer chains are rigid and cannot move past each other. When a polymer is heated and approaches the glass transition temperature, the resin softens and chain molecules, in effect, slip past each other when stress is applied. Stretching can be accomplished with the residual heat left in the resin at the time it leaves the extruder. Still another heating period is required by some resins to impart heat stability. This is analogous to an annealing operation, wherein the molecules which were aligned in stretching are given a period of freedom in which to reform crystallites and reduce the "locked-in" strains. When strains are locked in deliberately, a shrink-type film is produced. Such film tends to shrink back to its original size when reheated.

Thus, rigid, brittle, or even crystalline plastic materials such as unplasticized vinyl, polyesters, and polystyrene can be used in the flexible packaging field. Unoriented polyester films exhibit low and undesirable properties but, when oriented, become super-films with high tensile strength, high gloss, and crystal-like clarity. Orientation does not affect their other excellent quali-

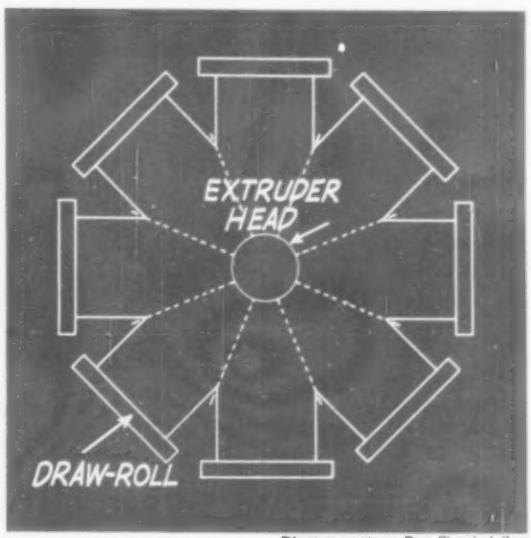


Diagram courtesy: Dow Chemical Corp.

Plan view diagram, radial-draw orienting machine.

* This is the first in a series of articles that will appear on biaxially oriented films.

ties such as gas and liquid impermeability.

Biaxial orientation of film probably came about as a result of a film-blowing technique. Dow's Saran (polyvinylidene chloride) is an example of this. It differs from normal blown film in that the bubble diameter is more than ten times the diameter of the parison leaving the die. Biaxial orientation occurs when the draw roll mechanism operates at a peripheral speed greater than the linear velocity of the film. In non-oriented film manufacture, such an arrangement of differential speeds is used to remove some of the stretch in viscoelastic materials. But when stretch is removed in this manner, it causes the material to exhibit unequal tensile values; greater in the machine direction and less in the transverse direction. Films thus produced have unbalanced tensile characteristics.

Processing studies indicate a set of optimum conditions for each polymer to obtain a film of maximum strength (tenacity). Variables to be considered include: melt index; extrusion or calendering temperature; extrusion or calendering rate; quench temperature; quench rate; drawing temperature; drawing rate; stabilizing temperature; and heat-set rate or rate of crystallization. The last four items are the conditions necessary to produce orientation along a single axis. Under the same conditions stretching repeated along the second axis produces a biaxially oriented product.

The success of biaxial orientation depends mainly on the type of machinery used, and the thermal treatment given the web. Machines consist of those which were borrowed (and modified) from the fabric industry, and those which originated in the plastics industry.

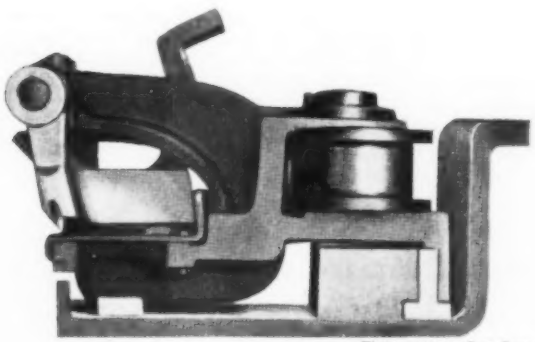


Photo courtesy: Cosa Corp.

Typical stenter-frame clamp.

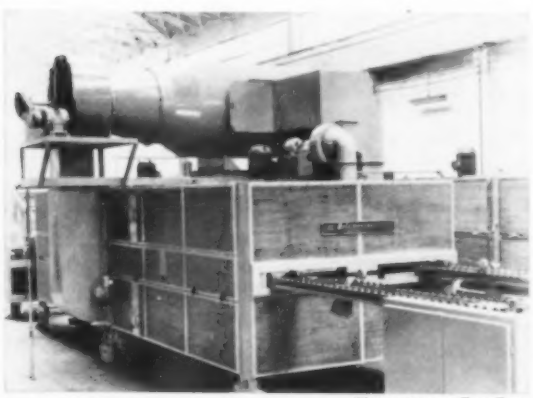


Photo courtesy: Cosa Corp.

Basic fabric machinery such as the Wits stenter-frame have been modified for plastic webs.

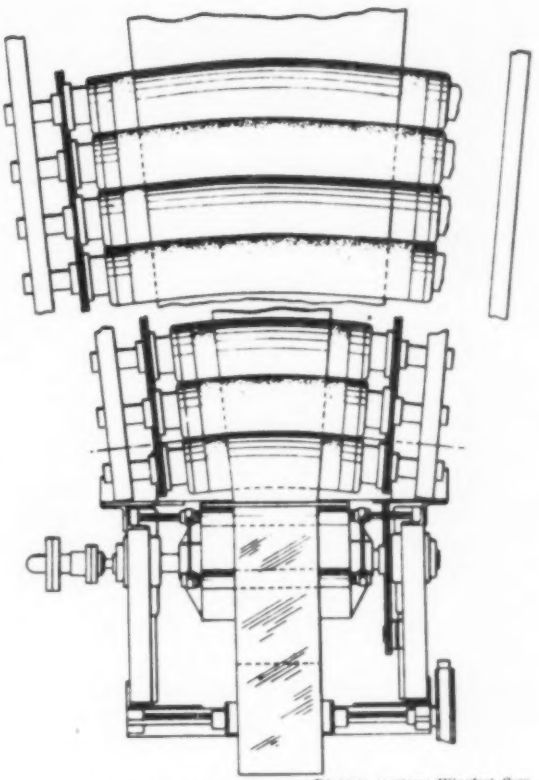


Diagram courtesy: Wingfoot Corp.

Expander roll orienting machine diagram.

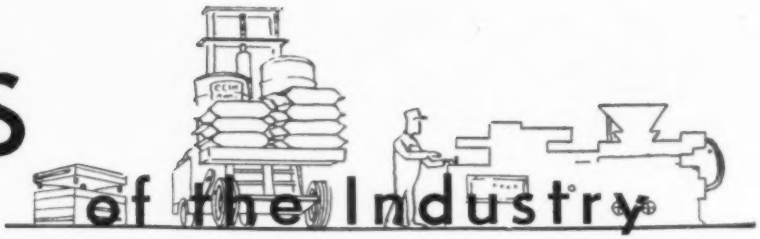
Photo courtesy: Rodney Hunt Machine Co.

Typical Expander Roll.

Since the production of oriented films has been primarily a captive operation, no standards exist in the industry. Each manufacturer has adapted his own machinery and has incorporated his own methods. No machines are commercially available at present. However, there is a standard stenter machine which can be modified to handle plastic webs. This machine is capable of expanding a web at least 400% while conveying it forward. Normally, this machine orients film only in the transverse direction.

There are some designs of stenter frames so completely modified that they no longer carry material forward, but instead operate as rotary units. A recent machine with radial draw units (developed by Dow Chemical Co.) pulls a web of plastic from a circular extrusion die. It is equipped with eight sets of draw rolls positioned around the periphery of the large web. Still another unit is an expander frame consisting of many expander rolls. Two-way stretch can be accomplished simultaneously by increasing the speed of the rolls in predetermined increments. —THE END

NEWS of the Industry



corporate name changes

J. P. Frank Chemical & Plastic Corp. is the new name for J. P. Frank Chemical Corp. and its associate company, Presto Plastic Products Co.

general/specific interest

The Pulverized Limestone Association has developed color plates in the brightness range of 94-96, as determined at 550 wave length on a G-E Spectrophotometer. The plates were made by Corning Glass from thermometer white glass, and were developed primarily for measuring the brightness of calcium carbonate. Plates are available on loan by writing the Association or A. B. Miner, National Gypsum Co., 325 Delaware Ave., Buffalo 2, N. Y.

SPE officers for 1961 are announced as follows: president, F. W. Reynolds, IBM; vice president—engineering, J. R. Lampman, General Electric; vice president—administration, J. Delmonte, Furane Plastics; secretary, M. F. Malon, Canadian Resins & Chemicals Co.; and treasurer, J. Berutich, Haveg Industries.

Hercules Powder Co. has obtained approval from the Food and Drug Administration for use of its polypropylene, Pro-fax, in products which contact all kinds of food.

Oshkosh Plastic Products, Inc., recently tested its 34-by 20-inch, 25-pound Thermosol mooring buoy by dropping it from a plane into Lake Winnebago at an altitude of 10,600 feet. Lakeside Plastics cast the buoy rotationally, filling it with plastic foam.

business developments

DeWitt Plastics, Auburn, N. Y., will now manufacture and sell the plastic fishing accessories formerly produced by the Lewis D. Hamel Co., Inc.

Godfrey L. Cabot, Inc., has consolidated three subsidiaries; Cabot Carbon Co., Cabot Shops, and Cabot Gasoline Corp., plus the parent company into a new corporated entity, Cabot Corp.

Allied Chemical Corp. has combined its polyethylene production and marketing with other plastics in a realigned Plastics Division. This division succeeds the older designation, plastics & coal chemicals division.

Devcon Corp. has formed a marine division to handle plastic steel demands by the heavy marine field. This material has been approved by the Navy for filling and repairing corroded metal hull surfaces.

E. I. du Pont de Nemours & Co.'s textile fibers department has announced the availability of Teflon FEP-fluorocarbon monofilament fiber in experimental quantities. Price is $35 per pound, and sizes are 250 and 1,200 denier.

F. J. Stokes Corp. has set up a packaging equipment department within its press division, to be headed by Larry C. Morehouse.

Thompson Chemical Co., Pawtucket, R. I., has announced the commercial availability of Truox lauroyl peroxide in 100-pound, polyethylene-lined fiber drums.

Rezolin, Inc., has announced a new series of high-temperature service epoxies for laminating and casting which require only a room temperature cure.

Synthane Corp. has installed complete fabricating facilities at its plant in Glendale, Calif. The West Coast operation began early this year as an expanded warehouse.

Adhesive Products Corp. has announced the development of Admold, a heat resistant latex for making rubber molds used in the casting of polyesters and epoxies.

Fluorocarbon Co. reportedly has the largest press ever designed for Kel-F sheet molding in operation at the Anaheim, Calif., plant. Capacity is 850,000 pounds.

new plastics companies

Zarn, Inc., a new blow-molding firm, opened its plant in Reidsville, N. C. Company officers are C. Ammondson, president; J. Rumsey, L. Niegelsky, and F. Von Ziegesar. Zarn also offers a complete silk-screen printing service.

Jomar Plastics, Inc., is a new injection molding firm, located in Port Chester, N. Y. The founder and president is Harold H. Schwartz, former research director of Empire Brush Co.

Polystructures, Inc., has been incorporated in Stoneham, Mass., to engage in research, development, and manufacture of reinforced plastic and foam products. President and treasurer is M. M. Hanoosh.

changes in ownership

Bemis Bros. Bag Co. has acquired controlling interest in Air-Formed Products Corp., of Nashua, N. H.

Fluorocarbon Co. has purchased the assets of the Kel-F plastic division, Raco Engineering Co., Santa Monica, Calif. The division has been moved to Anaheim, Calif.

market forecasts

Owens-Corning Fiberglas' Clare E. Bacon predicts that use of reinforced plastics by the transportation industry will jump from 34-million pounds to 105 million by 1965. He further predicts that these materials will become the major construction material in truck-trailer-bus fabrication during this interval.

SPI's executive vice president, William T. Cruse, predicts that the auto industry will consume a minimum of 500-million pounds of plastics by 1970.

agents, distributors & agreements

Chemo Products, Inc., East Warwick, R. I., has appointed four distributors in this country and Canada for its line of Teflon resin products.

Courtaulds Plastics Canada, Ltd., has been named Canadian distributor for AviSun polypropylene—film and fiber.

United Carbon Co., Inc., Houston, has licensed Sid Richardson Carbon Co., Fort Worth, to manufacture oil furnace carbon blacks by its process.

Switzer Brothers, Inc., Cleveland, O., producer of fluorescent paints and printing inks, has named key distributors throughout the United States.

Conforming Matrix Corp., Toledo, has named Kensington Associates, Kensington, Conn., its New England distributor for spray masking equipment.

Physical Sciences Corp., Pasadena, Calif., has appointed H. I. Thompson Fiber Glass Co., its sales distributor for high temperature and pressure wire, connectors, and potting compound. Thompson, simultaneously, was named distributor in 11 western states for the infusible urethane foam systems and coatings of Carwin Co., North Haven, Conn.

Marblette Corp. has named New London Tape Distributors, Inc., as service industrial users of the Marblette plastics line in the New England states.

Mitchell Plastics, Inc., Pittsburgh, has been named a certified fabricator for General Electric Textolite industrial laminates.

Barron Plastics, Inc., has been appointed distributor for Ram Chemical release agents in Ohio, Indiana, and Kentucky. Barron is located in Cincinnati.

Goodyear Aircraft Corp. has named Tee-Pak, Inc., Chicago, as a national distributor of reinforced plastic food handling bins and allied products.

changes in address

Fluorocarbon Co. has moved its entire Fullerton plant to larger quarters in Anaheim, Calif. The new facility doubles work space, and represents the third expansion move for the company in the past 5 years.

AviSun Corp. will move its executive offices to the Philadelphia National Bank Building as of December 1. Old location was Marcus Hook, Pa.

General Plastics Corp. has moved to larger quarters at 12414 Exposition Blvd., West Los Angeles. The building has 37,500 square feet of manufacturing and warehouse space, plus an added 3,000 feet of office and sales rooms. The firm is a leading fabricator of thermoplastic sheet.

Interplastics Corp. has moved its offices from 120 East 56th St., to 76-11 37th Ave., Jackson Heights 72, N. Y.

Plastic & Rubber Products Co. has moved to new quarters at 2100 Hyde Park Blvd., Los Angeles.

Dura Process Co. has moved its entire operation to 2011 Washington Ave. N., Minneapolis, Minn.

Plastiline, Inc., has moved its manufacturing facilities from White Plains, N. Y., to Pompano Beach, Fla. Old facilities will be retained as a sales office and warehouse.

Oronite Chemical Co., and its market affiliate, California Chemical Co., are moving their New York offices to 1 Rockefeller Plaza, New York City.

Lamart Corp., Clifton, N. J., has moved from 2 Waldo St., to new quarters at 16 Richmond St. The larger plant will provide improved research and production facilities.

Modular Molding Corp., Trenton, has moved its molded products division to 172 Bear Tavern Road in West Trenton, N. J.

new plants, labs & additions

Oronite Division, California Chemical Co., will market the added 41-million pounds of para xylene and 100-million pounds of orthoxylene to be produced at the Richmond refinery. New plants will be erected at the cost of nearly $17-million. The chemicals are used in the manufacture of polyesters and phthalic anhydride, respectively.

Owens Plastics Co., a new division of Owens Metal, Kansas City, Mo., has already doubled its blow molding facilities. The firm is now able to blow containers of a 55-gallon capacity.

Mobay Chemical Co. plans to construct additional facilities which will boost tolylene diisocyanate production to 40-million pounds annually. This is the fourth major expansion of the New Martinsville, W. Va., plant in five years.

General Dispersions, Inc., has occupied its new plant at 55 La France Ave., Bloomfield, N. J. The firm markets aqueous nylon dispersions under the tradename Genton, alcohol-based solutions as Gental.

Johns-Manville opened a multi-million dollar asphalt and vinyl-asbestos floor tile plant last month in Chillicothe, O.

Morningstar-Paisley, Inc., has opened an Atlanta plant for the production of industrial adhesives, polyvinyl acetate resins, and plastisols.

Johnson Mfg. Co., Chippewa Falls, Wis., has added 5,000 square feet to its die and extrusion equipment factory.

new plants, labs & additions

B. B. Chemical Co. has built a new addition to its plant in South Middleton, Mass. Interior of the cement-block structure is coated with BB's new textured urethane masonry facade coating in brilliant colors. Plant completion marks the first time the firm will produce its own resins, described as a high polymer type.

Hull Corp. has opened a Cleveland office at 20666 Beachwood Drive. Malcolm Adler is the manager.

Foster Grant Co., Inc., will build a polyethylene plant in Beaumont, Tex., adjacent to the Mobile Chemical Co. ethylene plant. Completion of the high-pressure unit is scheduled for mid-1961, and eventual plans call for polymerization and copolymerization of propylene, butylene, and other hydrocarbons.

Petro-Tex Chemical Corp., Houston, is erecting a multi-million dollar plant to produce maleic anhydride from low-cost C_4 hydrocarbons. It will adjoin present facilities.

Plax Corp. is building a 67,000 square foot plant in Anaheim, Calif.

Reynolds Metals Co. plans to expand its Grottoes, Va., plastics production facilities through a million-dollar program. Construction, begun in May, is in its final stages.

Stauffer Chemical Co. has opened a titanium trichloride unit at its Anderson Chemical Division, Weston, Mich. This material is used as a catalyst in the production of polypropylene.

Union Carbide Plastics Co. has opened a sales office in Minneapolis managed by P. W. Wood. It is located at 4010 West 65th St.

Clark-Schwebel Fiber Glass Corp. plans to build a $3-million fiber glass weaving and finishing plant in Anderson, S. C. Scheduled for completion by the first of the year, the facility will include a research and development lab, plastics engineering lab, and custom finishing plant. The firm is an independent affiliate of M. Lowenstein & Sons.

CTL Division, Studebaker-Packard Corp., is completing construction of a missile component plant in Santa Ana, Calif. Kent Doolittle will serve as general manager.

Sprout, Waldron & Co. has built another laboratory unit in Muncy, Pa., thereby adding 25,000 square feet of available floor space.

Northern Plastics Corp. is erecting a plant for the manufacture of structural laminated-plastic panels—near its other plant in La Crosse, Wis.

Waldron-Hartig Division, Midland-Ross Corp., has acquired another manufacturing plant in Mountainside, N. J. The plant is under the direction of Charles Aughinbaugh.

Dow Chemical Co. is constructing facilities for the production of polyethylene foam at Ironton, O. Completion is scheduled for June of next year. The plant will cover 61,000 square feet and will house 30-40 employes.

Celanese Corp. of America is constructing the nation's first commercial facilities for producing 1,3-butylene glycol, an intermediate used in the production of plasticizers. The plant, located in Bishop, Tex., will have an annual capacity of 25-million pounds.

Allied Chemical Corp. plans to erect a 50,000 square-foot addition to its Morristown, N. J., installation. It includes a two-story research lab, process lab, and a one-story chemical equipment warehouse.

Phillips Chemical Co. has added facilities to its Houston plant which will raise Marlex production to 100-million pounds annually.

Archer-Daniels-Midland Co. is constructing a multi-million dollar chemical center at Peoria, Ill. Completion is scheduled for the Spring of 1962.

Sheffield Plastics, Inc., has commenced construction of a plant which will double its extrusion floor space. Completion is expected by the end of the year.

Lucidol Division, Wallace & Tiernan, is building a $750,000 research laboratory north of Tonawanda, N. Y. The 20,000 square foot unit will house 30 research workers.

Commercial Plastics & Supply Corp., New York City, has opened a seventh sales office—in New Haven, Conn. Herbert Weil will manage the operation.

Rohm & Haas Co. is building a 130,000 square foot warehouse in Bristol, Pa. Estimated cost of project—$800,000.

Minnesota Mining & Mfg. Co. is erecting a chemical plant in Decatur, Ala., for the Kel-F line now produced in Jersey City. Operations will be shifted in the spring of 1961.

B. F. Goodrich Chemical Co., has opened its vinyl plant in Long Beach, Calif. Designed to handle all West-Coast requirements, the unit will employ 40 persons.

United Carbon Co. plans to erect a 64-million pound carbon black plant in Southern California.

Reichhold Chemicals, Inc., plans to expand its Jacksonville, Fla., polyester and alkyd facilities by a 10-million pound/year unit.

Fasson Products, a division of Avery Adhesive Products, opened a 18,000 square-foot addition to its plant in Painesville, O.

Carl N. Beetle Plastics Corp., Fall River, Mass., plans to increase its manufacturing space by two thirds, or another 30,000 square feet.

H & R Plastics Industries, Inc., polyethylene film producer, plans to double its work space in Nazareth, Pa.

Tel-A-Sign, Inc., has opened a plant at 3401 West 47th St., Chicago, and now has 130,000 square feet of floor space.

Filon Plastics Corp. is building a 12,000 square foot plant in Skokie, Ill.

Ultrasonic Industries, Inc., has opened a sales and service office in San Diego, Calif.

Names in the News

Anthony Latona

Anthony Latona has been named manager of the adhesives division's latex and plastisol compounding and development laboratory, B. F. Goodrich Industrial Products Company. He joined B. F. Goodrich in 1952 as a materials engineer after a year as a chemist with the Ohio Agricultural Experiment Station at Wooster.

Karl Eklund is now director in charge of research and applied ion physics at Radiation Dynamics, Inc. Dr. Eklund was most recently engaged in electron and gamma ray spectroscopy associated with charged particle reactions at the Pegram Nuclear Physics Laboratories of Columbia University.

Henry S. Winnicki has been named vice president of the chemical divisions of Food Machinery and Chemical Corp. He will be in charge of the central engineering, process development, and patent departments. Before his appointment, Mr. Winnicki was manager of FMC's Chemical and Plastics division.

Henry W. Wyman has been elected president, and **Harry A. Russell,** executive vice president, of Pantosote Co. Both are former vice presidents of the company, which manufactures vinyl film and sheeting.

T. A. Langstroth has become technical director of the chemicals group at Sun Chemical Corp. Under Mr. Langstroth's direction, it is planned to broaden product lines and enter new markets.

Thomas DuFour is manager, marketing, for Hexcel Products, Inc.'s new Applied Plastics division. He will be responsible for initiating and supervising marketing programs for foams, adhesives, coatings, hardening systems, and other products manufactured by the division.

John J. Paredes has been advanced to the post of midwest regional sales manager of Geigy Industrial Chemicals in Chicago. He came to Geigy in January 1959 as field sales representative from Monsanto Chemical Co., where he was sales supervisor for the organic chemical division's special chemicals department. Richard J. Michelini has also joined Geigy Industrial Chemicals' sales force. Prior to this he was associated with Armour Chemicals and Virginia Smelting Company.

Harry D. Armitage, manager of the New York office of Emery Industries, Inc., has retired after 35 years of sales in the New York area. Climaxing his career, he was presented with the Distinguished Salesmen's Award of the Cincinnati Sales Executives Council at their award dinner on May 11.

Don Prideaux

Don Prideaux is now managing Rezolin, Inc.'s eastern division. Mr. Prideaux, formerly research and development engineer and field engineer for Rezolin, will be at the new office and warehouse in Newark, N. J.

Stanley C. Levy has been named assistant product manager of the industrial division of Kordite Co. During the past two years he has been a district sales manager and senior salesman for the company.

Fred J. Meyer is no longer associated with Texas Plastics, Inc.

J. P. Knopf, who has been secretary-treasurer of Tube Turns Plastics Inc. since its organization in 1954, was recently elected a vice president. The firm, an affiliate of Chemetron Corp. and Jackson & Church Co., injection molds thermoplastic fittings for industrial piping.

The sales department of the plastics division of Koppers Company, Inc., has made four new appointments. **Harold D. Cooper,** formerly polyethylene product manager, has been named assistant sales manager of the plastics division. Previous manager of the New England district sales office for this division, **M. D. Fullerton,** is now polyethylene product manager. **E. C. Hilkert** has been appointed New England district manager, and **D. G. Harris** manager of the division's sales office. Both Mr. Fullerton and Mr. Hilkert joined Koppers in 1942. Mr. Harris was formerly with Blue Cross, Shields Rubber Co., and U. S. Rubber Co.

H. D. Cooper

Leonard G. Nussbaum has been appointed production manager, Chemicals & Plastics division, Food Machinery and Chemical Corp. He is succeeded as resident manager of the division's Nitro, W. Va., plant by **A. G. Draeger.** Both men had previously been production managers.

L. W. Seigle is now manager of chemical development for Allied Chemical's National Aniline Division. He will be responsible for introducing and commercially developing new chemical products, and handling their initial marketing until commercial acceptance warrants transferring them to the sales organization. Dr. Seigle joined National Aniline's research staff in 1939 at Buffalo, New York.

Ralph M. Dudley

Ralph M. Dudley has been added to the management staff by Nosco Plastics, Inc. He will work on expanding Nosco's program in decoration by spray painting, hot stamping, screening, and vacuum metallizing.

Max E. Roha has been named manager of plastics research at the B. F. Goodrich Co. Research Center, Brecksvile, O. Dr. Roha, who joined Goodrich in 1949, was formerly a senior scientist in the plastics research group.

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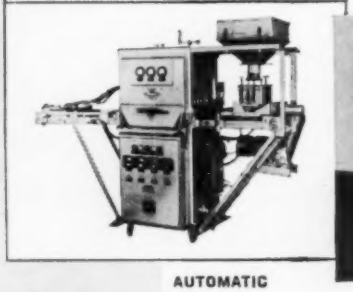

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New Materials

For more information check Readers' Service Card (p. 89)

Release Coating for Containers

Tar-Dux, a plastic release coating developed by Dri-Dux Division, Resisto Chemical, Inc., prevents such materials as adhesives, resins, and waxes from adhering to fiber or paper containers. Tar-Dux is a solvent-free, water dispersion of resins, milky white in appearance, which forms a transparent film when dry. When applied to paper products, oven drying at 250° F. or higher for 30-60 seconds is sufficient.

Advantages claimed for the material are that it is inert, water insoluble, scuff resistant, and resistant to hot materials at pour temperaures up to 400° F. Further, it will not flake. Tar-Dux can be applied by spraying, rolling, and dip or slush coating.

Readers' Service Item 1

Glass Mat Laminates

According to Westinghouse Electric Corp., Micarta polyester-glass mat laminates for use in electrical apparatus resist deterioration by flame, moisture, leakage currents, arcing, and impact. Good physical properties are retained when heated to temperatures up to 130° C.

The laminate is available as thick plate, angles, sheets, and in custom shapes. Monolithic plates without glue line come in thicknesses up to two inches and in rectangular shapes up to 36 inches square. Angles up to 60 inches long are available in ⅛-inch material, up to 40 inches long in 3/16-inch material. Sheets, in red or brown, are 36 inches wide, 36-72 inches long, and ⅛-⅝ inch thick.

Readers' Service Item 2

Tooling and Repair Compound

An epoxy tooling and repair compound, available as a putty and as a liquid, has been placed on the market by Devcon Corp. Devcon 100 and 101 are used for making patterns, models, and other products where light weight and low cost castings are desired.

No heat or pressure is required for cure. After approximately three hours at room temperature the mixture becomes a rigid mass that can be drilled, sawed, or machined. One pound, including hardener, occupies 16.3 cubic inches. The material resists most chemicals and oils, and will bond to metals, wood, ceramics, and other materials. Four color concentrates are available for coding.

Physical characteristics of cured Devcon 100 and 101 are:

Tensile strength, psi	7,500
Compressive strength, psi	16,500
Flexural strength, psi	10,750
Rockwell F hardness	93
Shrinkage, in./in.	0.0006
Impact strength, ft. lbs./in. notch	0.8
Specific gravity	1.71
Pot life at 75° F., hrs.	1
Setting time at 75° F., hrs.	2

Readers' Service Item 3

Vinyl Plastisol

Dennis Chemical Co. is offering its No. 9225 Denflex plastisol for molding products with good wear resistance and low temperature flexibility. The compound can be processed by slush casting or hot dipping to produce bellows, grease boots, sleeves, hoods, etc. It has a rubber-like feel and resistance to gasoline and oils.

Liquid No. 9225, which should be stored below 90° F., weighs 9.50 pounds per gallon and has a Brookfield viscosity of 400 cps. Typical properties of fused resin, which may be colored as desired, are:

Shore A durometer hardness at 90° F.	52
At −20° F.	64
Tensile strength, psi	1,400
Ultimate elongation, %	500
Flex temperature, ° F	−65

Readers' Service Item 4

Epoxy Casting Resin

Stycast 1231, a fire retardant epoxy casting resin which adheres to metals, plastics, and ceramics, has been developed by Emerson & Cuming, Inc. It is stable between —100° F. and 350° F.

The material requires only slight stirring before addition of catalyst. With catalyst, its viscosity at room temperature is low. Because of low thermal coefficient of expansion and high heat stability, large embedments can be made. It can be color coded, but is normally supplied in black.

Thin sections of cured Stycast 1231 repeatedly introduced to a flame will, on each occasion, immediately extinguish. The cured material can be machined with carbide tools.

Readers' Service Item 5

Amine-Type Epoxy Hardeners

Reichhold Chemicals, Inc., has made Epotuf hardeners 2611 and 2613, for room temperature cure of epoxy resins, commercially available. These light amber, liquid, modified amine-type hardeners are reported to reduce blushing or oily surface film formation, even on thin films, and to function as flexibilizers. In addition, they may be used in combination with other amine-type hardeners or with polyamides and polysulfides to impart additional flexibility and resiliency or to speed room temperature cure.

Although the hardeners are not recommended for high temperature applications, they are useful in casting, potting and encapsulation, patching compounds and repair putties, adhesives, etc.

At 25° C., Epotuf 2611 has a Brookfield viscosity of 2-3 poises: 2613 has a viscosity of 35-45 poises. Each has a pot life of 7-8 minutes. A ⅛-inch section will gel in 12-15 minutes. Peak exotherm temperature of a 120 gram mass of 2611 is 200° C.; 2613, 155° C.

Readers' Service Item 6

Two-Part Casting Compound

Copy-Cast, a two-component filler, sealer, and bonding agent developed by Future Chemicals Mfg. Co., can be used for testing dies, repairing casting and sheet metal rejects, and duplicating. Reportedly non-toxic, it remains workable for 3-4 hours and hardens at room temperature in 6-8 hours or at 200° F. in ten minutes.

Cured castings can be machined and finished. They may also be modeled or sculptured with woodworking tools.

Readers' Service Item 7

Two Resin-Glass Laminates

A flame retardant epoxy-glass laminate and a high temperature Teflon-glass laminate are available from Mica Insulator, division of Minnesota Mining & Manufacturing Co. The epoxy, No. 6097 Lamicoid, has the desirable electrical properties, moisture resistance, strength, and machineability for printed circuits. The other, designated No. 6098 Lamicoid, is characterized by high chemical resistance, excellent electrical properties, resistance to mechanical abuse, and low cold flow under heat and pressure. Both are available, under the name CuClad, with 1- or 2-ounce copper bonded to either or both sides. CuClad No. 6098 can be used for high temperature printed circuits and microwave applications.

Maroon in color to identify its flame retardancy, No. 6097 Lamicoid reportedly distinguishes itself within two seconds

after the removal of a flame. Typical properties of samples include:

	No. 6097	No. 6098
Density, g./cc.	—	2.2
Tensile strength, psi., lengthwise	—	26,000
Flexural strength, psi., lengthwise	53,000–58,000	16,000
Crosswise	50,000	—
Impact strength, ft. lbs./in. width, lengthwise	—	13.0
Ft. lbs./in. notch, lengthwise	7.1	—
crosswise	6.6	—
Dielectric strength, KV, parallel to lamination, step by step	—	45
Arc resistance, sec.	—	185
Dielectric constant at 1 MC	5.0	2.68
Peel strength of copper-clad sheet, lbs./in.	11	10

No. 6097 Lamicoid sheet is available in sheets 36 by 42 inches, in thicknesses from 1/64 inch to 2 inches. No. 6098 comes in 17 by 37 inch sheets, 0.006-0.250 inch thick.

Readers' Service Item 8

Silicone Damping Agent

A silicone-organic copolymer fluid for the control of cell structure in polyurethane foams has been introduced by the silicone products department of General Electric Co. Straw-colored XF-1034, developed for use in one-shot polyether flexible foams for upholstery, seat cushions, garment insulations, etc., will produce a small and uniform cell structure in concentrations of 0.5-1% of total formula weight. It also finds application as a cell structure controller for freon-blown rigid foams and as a mold release agent where the operating temperature is low.

Water-soluble XF-1034, a dimethyl polysiloxane and polyoxyalkylene copolymer, has the following average properties.

Viscosity, 25° C., cstks., approx.	900
Viscosity temperature coefficient	0.83
Specific gravity, 20/4C	1.02
Refractive index, 20° C.	1.4454
Surface tension, 25° C., dynes/cm.	26.8
Flash point, open cup, °F.	500
Fire point, open cup, °F.	520
Pour point, °F.	−15

Readers' Service Item 9

Three Vinyl Stabilizers

Argus Chemical Corp. has announced the formulation of three non-toxic vinyl stabilizers, Mark 33, Mark 34, and Mark 35. All three are claimed to provide excellent stability when used in plasticized formulations and to be particularly effective in the stabilization of rigid compounds.

Any one may be used as the sole stabilizer system for rigid compounds. Because they are non-liquid and do not require the addition of epoxidized oils, they avoid the reduction in the heat distortion temperature level and loss of other important physical properties which may accompany the use of liquid plasticizers and stabilizers.

Mark 33 will provide extremely long term heat stability in rigid stocks, reportedly equaling or bettering that of the alkyl tin mercaptides. Since the initial color of a rigid compound stabilized with Mark 33 is yellowish orange, it is not recommended for applications requiring good initial color.

Mark 34, supplied in paste form, is recommended for compounds where good initial color is important. Long term stability is less than that obtained with Mark 33 or Mark 35, but it supplies the best clarity.

A compromise, Mark 35 has better initial color than Mark 33 and better length of stability than Mark 34.

Readers' Service Item 10

Yellow-Red Pigment

Graphtol 1019-0 special red toner has been designed specifically for use in gravure printing. According to Sandoz, Inc., this brilliant, yellow-red shade will maintain its masstone shade through a wide range of pigment/binder ratios. Light fastness in tint tone is not nearly as good.

Essentially, this pigment is non-bleeding and may be used in tin printing where over-striping or over-printing is necessary. It is also recommended for gravure and printing inks, foil and aluminum coatings, and plastics.

Readers' Service Item 11

Rolled Epoxy-Glass Tubing

Continental-Diamond Fibre Corp. has announced the availability of rolled epoxy-glass tubing known as Dilecto GB-125DFR. Made from epoxy resin impregnated glass cloth that is rolled and cured on mandrels, the tubing is designed for use in transformers and other heavy electrical equipment and in military electronic equipment. For such use it features desirable physical properties, flame retardance, arc resistance, and high flexural strength at 150° C.

Dilecto GB-125DFR tubing is available in 3/16-inch to 12¾-inch I.D. and ¼-inch to 13½-inch O.D. with a minimum wall thickness of 1/32 inch. Tubing length is 38 inches.

Readers' Service Item 12

Secondary Vinyl Plasticizer

A secondary plasticizer developed to provide lower formulating costs and good performance characteristics with vinyl compounds is being marketed by Monsanto Chemical Co.'s Organic Chemicals Division. Trademarked Santicizer 216, this extender is claimed to give good low-temperature flexibility, light stability, and low volatility to polyvinyl chloride plastisols and extrusions. When used in a ratio with DOP of 6:1 or 7:1, there is no exudation.

Typical properties include:

Refractive index, n_D^{25}	1.4895
Viscosity, SUS 100° F.	178.7-182.6
Specific gravity	0.873
Distillation range @ 5 mm Hg. °C., 50%	227
Average molecular weight, approx.	300
Viscosity, Brookfield HAT viscosimeter, #1 spindle, 23° C., @ 100 rpm, cps.	127
At 50 rpm, cps.	104

Readers' Service Item 13

Epoxy Polyester Coating

John L. Armitage & Co. has formulated a clear epoxy polyester coating for protection of treated and non-treated decorative aluminum products and surfaces. The coating retains the luster of the base metal and adds resistance to mar, burns, cracking, and staining. Viscosity of the coating, which may be sprayed or dipped is 14 seconds #4 Ford Cup at 77° F.

Readers' Service Item 14

Polypropylene Film

A heat-sealable, longitudinally polypropylene packaging film, Kordite 1500, is available from Kordite Co. Reportedly superior to cellophane in moisture protection and shelf-life, the film may be used with most existing automatic packaging machinery. It is being produced ½-mil thick, with a tensile strength 20,000-40,000 psi, which should cover 50,000 square inches per pound. Unlike most polyolefin films, Kordite 1500 is greaseproof. Transparency, sparkle, and tear tape properties are similar to those of cellophane.

Readers' Service Item 15

Polyester Paste Colors

Soft-Flow pastes, made by Plastics Color Co., Inc., are reported to offer uniform viscosity, easy dispersability in the resin, and pourability for repackaging. They come in yellows, reds, blues, green, gray, black and white.

Readers' Service Item 16

New Equipment

For more information check Readers' Service Card (p. 89)

Magnetic Separator

A permanent rotating field laboratory magnetic separator has been developed by Carpco Manufacturing, Inc. Designated Model RF-1660, the unit is intended to remove highly magnetic substances from granulated materials in the dry state.

A vibrating feed hopper sends the material to be separated under a cylindrical stainless steel housing. In the housing, magnets rotating on a hub in a direction counter to the downward fall of the material attract magnetic contaminants. Up to 600 pounds per hour can be fed.

Readers' Service Item 21

Power Input Controller

By switching power on and off in a preselected rhythm, Type 8000 Thermolyne controller, produced by Thermo Electric Mfg. Co., can be used to control flask heaters, water baths, small furnaces, etc. This electrothermally-actuated, stepless instrument, smaller than a four-inch cube, automatically compensates for variations in voltage and ambient temperature. Built-in magnetic arc suppression is designed to lengthen contact life and reduce sparking hazards. Circuit is rated at 115 volts AC, 1,500 watts.

Readers' Service Item 22

Cylindrical Band Heaters

Vulcan Electric Co. has developed a series of cylindrical band heaters for plastic molding and extruding machines. An aluminized steel sheath and one-piece alloy clamping band assure rapid heat transfer. Stock heaters come in 1½-inch widths, 1⅝- to 18-inch I.D., and a wide range or wattage and voltage ratings. Special sizes can be ordered.

Readers' Service Item 23

Skin Packaging Machine

According to Product Packaging Engineering, several improvements have been made on its Model 24 Park-O-Vac skin packaging machine. Infrared ovens have been enlarged and oven reflectors redesigned to provide a more even distribution of heat. Vacuum reservoir capacity has been double, and vacuum control sensitivity increased. A hand wheel controls oven height.

Maximum platen size is 20 inches square; maximum depth of draw, 7 inches. Most thermoplastic film and sheet up to 250 mils thick can be used.

Readers' Service Item 24

Industrial Chilling System

Application Engineering Corp. has developed a control unit and system for rapid cooling during injection molding, extruding, and related forming processes. Model TP is a self-contained system, including water pump and storage tank; Model S, a water recovery unit for ceiling suspension, does not include pump and tank.

Among controls incorporated in Multitam compressor motor are high pressure cut-out, motor circuit breaker, overload relay, and low pressurestat. A safety thermostat protects unit from freezing. A large thermometer on TP models shows the temperature at a glance. Chilling component and piping are insulated to prevent condensation. Refrigerant is non-toxic and refrigerant capacity control valves are standard on all makes.

Both models are made in three sizes, in heating capacities of 60,000; 113,000; and 210,000 BTU per hour. Standard models have 208-220 volt/ 3-phase/ 60 cycle motors.

Readers' Service Item 25

Blow Molding Machines

The 450 series of blow molding machines from Auto-Blow Corp. will mold large toys, housewares, industrial products, and containers up to 30 gallon capacities. The four station model molds items to 14 inches in diameter and 48 inches in length at dry cycle rates up to 6,000 parts per hour. Two-station models mold pieces to 14 inches deep, 28 inches wide, and 48 inches long. The machines will handle 450 pounds of material per hour from continuously running 4½-inch extruders.

Platens are key slotted for short runs with frequent mold changes. Tapped holes facilitate mounting a wide variety of molds. Alignment of molds with die heads on the manifold is assured by a six-way press adjustment. A two-stage molding cycle, with only linear motion, provides maximum molding efficiency. While blowing is usually done through the head, blowing through needles can be accomplished.

Readers' Service Item 26

Vacuum Diffusion Pumps

Consolidated Vacuum Corp. has added two high speed vacuum diffusion pumps, with casing diameters of two and ten inches, to its PMC pump line.

The line is reported to maintain peak speeds up to 140% higher, over longer pressure ranges, than speeds attainable with the most efficient conventional high vacuum pumps of comparable size. This is due to several design innovations. An immersion heater in the boiler reservoir speeds oil vaporization by direct heat contact with the pump fluid. Extension of this heater assembly above the fluid level insures most effective heat input. Jet assemblies of sturdy cast aluminum allow for a shorter, slightly wider pump casing, resulting in optimum diffusion pumping with a minimum of vapor backstreaming.

Operating range is 2×10^{-7} to 1×10^{-2} mm. Hg. The two-inch model pumps at a speed of 105 liters per second over the pressure range of 9×10^{-5} to 3×10^{-3} mm. Hg. The ten-inch pumps at 4,100 liters per second over the pressure range of 5×10^{-5} to 1.5×10^{-3} mm. Hg. A full load limiting forepressure of 0.35 mm. Hg to no load limiting forepressure of 0.6 mm. Hg is achieved by the pumps.

Readers' Service Item 27

Long-Range Static Eliminator

The Simco Aerostat, made by Simco Co., will neutralize materials up to four feet away. It consists of a centrifugal blower incorporating a static-neutralizer head in the air outlet. Ionization produced in the neutralizer head is carried on the air stream from the blower to the material to be discharged.

Two sizes, with effective lengths of 10 and 20 inches, are available. For discharging large parts or wide materials, the units may be butted together end to end to create a continuous neutralizing field. Both sizes are available with standard or shock-

Simco Aerostat.

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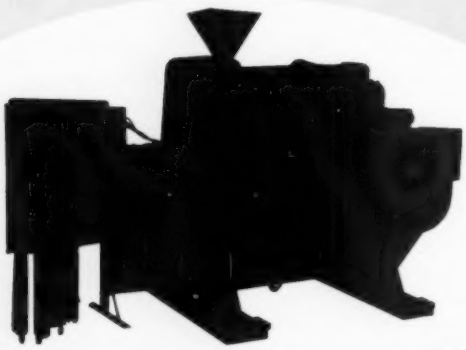

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less neutralizer heads.

The Aerostat can be used for spraying large plastic parts, including those with deep indentations and intricate shapes. Molded pieces can be neutralized inside and outside simultaneously, by the use of two Aerostats. Static in tumbling and deflashing operations can be minimized to prevent dust attraction.

Readers' Service Item 28

Extrusion Cutter

Model IV-S Versa Cutter for high-speed processing of plastics and other materials features precision pinch roll take-off synchronized with the action of the cutting blade. It is designed and manufactured by Foster & Allen, Inc., who note that improvements in new units can be installed on recent Model IV's. The model also features a redesigned Series 200 Reeves Vari-Speed Motodrive with wider speed variation, smoother power flow, and longer belt life. The Reeves unit is equipped with a 1½ hp. synchro-speed motor, which maintains predetermined speed despite voltage fluctuations.

Casters permit the Versa Cutter to be moved from one extruder line to another. It occupies floor space 41½ by 29 inches, and is about 50 inches high when the guard cutting head is in place. Cutting speeds can be adjusted from 7,600 cuts per minute to one cut every eight minutes. Extrusions of any shape or size can be cut up to diameter of two inches.

Readers' Service Item 29

Front- and Back-Doored Oven

Electric Hotpack Co., Inc., is marketing an industrial oven with both front and back door openings. Model 8362, with temperatures ranging from 95-500°F., has a chamber 42 by 30 by 52 inches. Exterior measures 66½ inches wide, 46 inches deep, and 82 inches high. Loading ease is augmented by use of a foot-operated door release, and the chamber floor is reinforced to withstand a 500 pound workload. Eye-level controls include an adjustable automatic thermostat for control within +5° F. and an overtemperature controller that prevents chamber temperatures from exceeding thermostat levels.

Heaters are nichrome wires in porcelain refractories. Air circulation system includes high velocity blower, adjustable air intake vents, velocity damper, and adjustable exhaust stack.

Readers' Service Item 30

75-Ton Hydraulic Press

Kingsbacher Murphy Co. is now manufacturing a 75-ton hydraulic press that can be used for molding, laminating, or testing plastic materials. The press has a four-column welded steel frame which provides precision self alignment and self leveling of the platens.

Electrically-heated platens, 19 inches square, are furnished for steam heating or water cooling. A cal rod heater cast in the platen produces 4,000 watts. Each platen has an adjustable thermoswitch connected to a sensitive mercury relay. This combination accurately controls platen temperature up to 600° F. Maximum daylight opening between platens is 11 inches. A removable adapter, standard equipment, allows for an opening from zero to six inches, or from six to 11 inches.

Readers' Service Item 31

Spindle Drilling Machines

Kramer Machine Co. has developed an economy series of vertical multiple spindle drilling or boring machines in lengths from four to ten feet. These Willard machines can be used on most plastics, including both polyethylene and glass-reinforced polyester laminates.

The new line, known as the Scotsman series, is designed to bring lowered pro-

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duction costs as well as the accuracy, uniformity, and efficiency of multiple drilling within the reach of the smallest production plants. The machine will handle up to 14 spindles, either individually or dual powered, of several types and sizes, and powered up to two hp. per spindle. Feed to and from the drill is controlled by a foot valve.

Readers' Service Item 32

Small Wheel Pneumatic Grinder

Small wheel pneumatic grinders adjustable to any operating speed between 16,000 and 25,000 rpm. are available from Thomas C. Wilson, Inc. Operating speed can be adjusted for the optimum tool speed for each material by rotating a calibrated ring throttle speed regulator.

The grinders will drive small grinding wheels, rotary files, carbide burrs, routers, and sanding or cutting discs. Weight is 1¾ pound. Model 921-35, with ⅜ by 24 threaded spindle, is 6⅜ inches long. Model 921-45, with ¼, 3/16, or ⅛ inch collet, is 5¾ inches long. Series 921, also available in single-speed models with lever or push-button throttle control, features three-bladed impulse motors, air-cooled heavy duty bearings, and hardened, ground, and honed cylinders.

Series 921 pneumatic grinder.

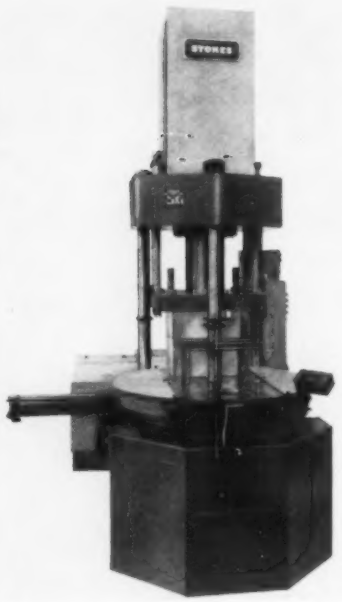
Readers' Service Item 33

Insert-Molding Transfer Press

A series of semi-automatic transfer molding presses recently introduced by F. J. Stokes Corp. is reported to permit inserts to be loaded more easily and accurately with almost no lost press time. The presses carry two identical lower mold halves, one of which is molding while the other is being loaded. Model 744 design has fast clamping speeds which recommend it for compression molding also.

The model has a horizontal turntable which carries the identical mold halves. The finished pieces are ejected automatically from the mold by rising vertical pins. The operator removes the pieces and load a fresh charge of inserts and preforms while the other half is in the press. The turntable is mounted on the stationary bottom platen and rotates about the front tie-rod. The table is rotated by a hydraulic cylinder which actuates a rack for 180° clockwise, then 180° counter clockwise. The cylinder is powered by the main hydraulic system of the press.

Specifications of the 150-ton capacity model 744 follow:



Transfer molding press with rotating table for loading ease.

Clamp stroke, inches, max.	14
Distance between platens, in., open	31
Closed	17
Platen area, in., L-R x F-B	22 x 16
Clamp ram speeds, in./min., closing and opening	400
Intermediate	72
Pressing	0–22
Bottom ejection stroke, in.	6
Ejection pressure, tons	13
Bottom transfer capacity, tons	30
Bottom transfer stroke, in.	6
Bottom transfer speeds, in./min., advance	360
Pressing	0–100
Return	300
Height, in.	138
Height, floor to top of rotating table, in.	39

Readers' Service Item 34

Retractable Probe Tips

Atkins Technical, Inc., has announced a line of retractable probe tips for making temperature readings at desired depths of non-rigid masses such as chemicals and plastics. The needle tip of the probe is protected within a sheath when not in use. When temperature readings are desired, the user turns a dial selector on the probe. This permits insertion of the tip into non-rigid material to the proper depth for obtaining an accurate temperature reading.

The probes are water tight and abrasion proof and are designed for use with Atkins A+ Thermophil instruments covering −150° to 410° F. temperature on multiple scales. They have been designated H20AF.

Readers' Service Item 35

Improved Bag Sealer

Bag-O-Matic Packaging Equipment Co. has announced several improvements on its automatic recycling polyethylene heat sealer which seals 3,000 small bags or 1,500 large bags an hour.

An automatic safety slip clutch prevents locking and permits flap-over sealing of packages up to ⅜ inch thick, in addition to regular lip-sealing. One-knob heat control eliminates both thermostat and heat switch. Heat is maintained within 2° by a new input heat regulator. A Teflonized sealing bar eliminates Teflon tape and a nylon cam wheel, the need for oil and grease.

Readers' Service Item 36

Tumbling Barrel Unit

Tumb-L-Matic, Inc., is offering a barrel finishing unit for producing fine finishes on precision parts. Designated Model XLC-2120, the barrel is mounted in a welded iron frame and supported in bearings at each end of the shaft. The hexagonal barrel is 20 inches in diameter and 21 inches long. It can be supplied unlined or with abrasive resistant rubber for wet or dry processes.

Barrels are supplied with two types of drives, one involving constant speed set to user requirements, and the other variable in a ratio of 10:1. Standard equipment includes a magnetic start and stop electric control switch with thermal overload protection. Beneath the barrel is a work and compound separation system consisting of two screens. One retains the work and the other the media.

Model XLC-2120 tumbling barrel.

Readers' Service Item 37

POLYSTYRENE

OR

POLYSTYRENE SCRAP

PLUS

COSTYRENEBLAK®

EQUALS

AND

...Columbian Costyreneblak offers many advantages. It's **CLEAN** . . . carbon black predispersed in chips that are relatively dustless. Clean-up time and chance of contamination are at a minimum. You get **FASTER COMPOUNDING** too . . . no pre-milling necessary . . . better dispersion, less rejects. Finally, Costyreneblak means **ECONOMY**. . . usually 25% less carbon black is required with this dispersion than when you use loose carbon black. Get all the facts . . . today.

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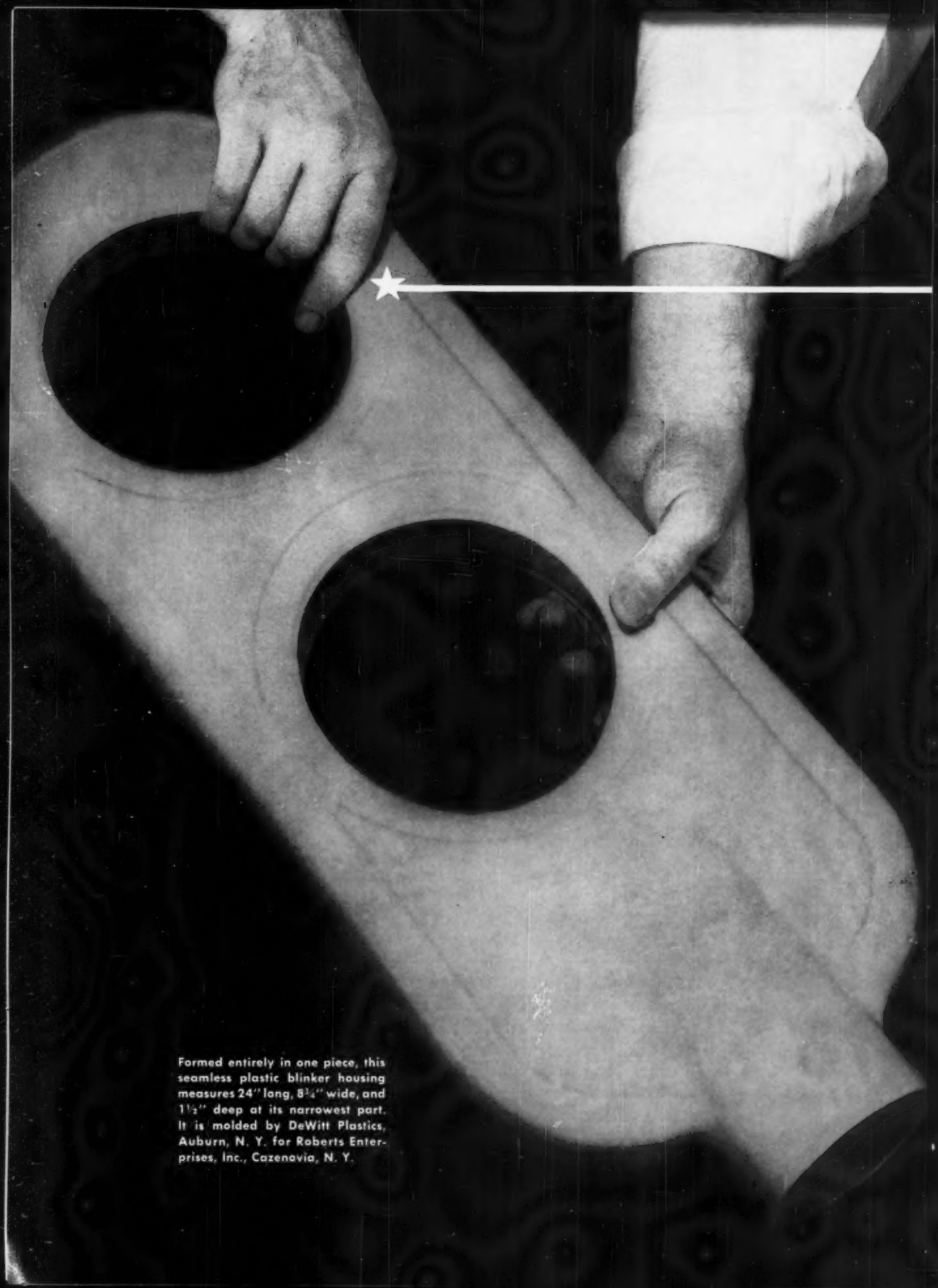
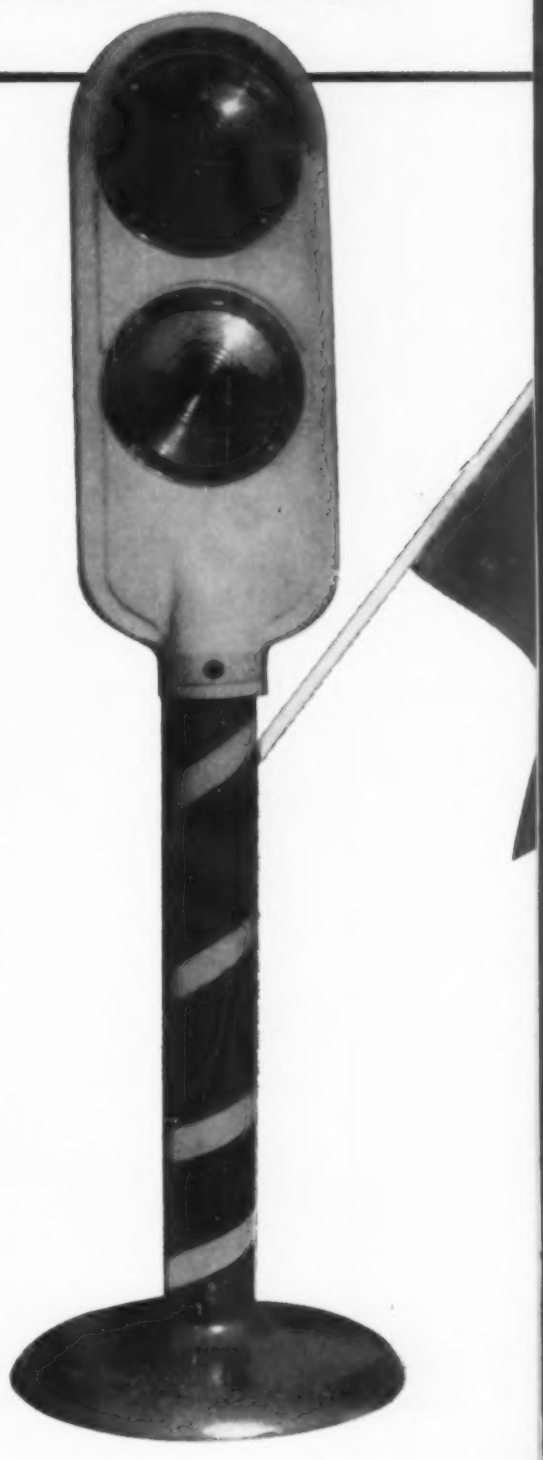
380 Madison Avenue **New York, N. Y.**



Formed entirely in one piece, this seamless plastic blinker housing measures 24" long, 8¾" wide, and 1½" deep at its narrowest part. It is molded by DeWitt Plastics, Auburn, N. Y. for Roberts Enterprises, Inc., Cazenovia, N. Y.

STOP...LOOK WHAT'S NEW

IN BLOW-MOLDED POLYETHYLENE!



This flashing road barricade is a beacon of safety for motorists. Its yellow plastic blinker housing shows something else, too. Good design. Selection of the *right* process, the *right* material. Only blow molding could make this part in one piece. And BAKELITE Brand high-density polyethylene provides the durability to stand long, tough outdoor use.

The background of UNION CARBIDE in blow molding dates from the earliest application of polyethylene to squeeze bottles. At our laboratories in Bound Brook, N. J., a battery of all major types of blow molding machines reproduces practically every set of production line conditions encountered in the process. As a result, BAKELITE Brand polyethylenes are engineered for performance in machine and product alike.

You can get every type of polyethylene for blow molding from Union Carbide Plastics Company. BAKELITE Brand polyethylenes range from low to high density materials, including .95 to .96 density types. Nowhere else in the industry is the list so complete. You get the benefits of one-source selection.

For information on how UNION CARBIDE materials and experience in blow molding can help you develop a successful product, write Dept. FS-105, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada:* Union Carbide Canada Limited, Toronto 12.

UNION CARBIDE

BAKELITE and UNION CARBIDE are registered trade marks of Union Carbide Corporation.

Plastics Applications

For more information check Readers' Service Card (p. 89)

Vinyl Hanging Ceilings

A prefabricated hanging ceiling unit, designed to eliminate eye strain by spreading light in all directions, is being marketed by Diffusa-Lite Co. Vinyl sheeting with 5/8-inch depth of corrugation is suspended in frames of extruded aluminum.

Light behind Vinylux ceilings will be diffused evenly without glare. Vinylux will conceal pipe, ducts, valves, and lighting fixtures while still providing free access to them. The vinyl will melt in case of fire.

Readers' Service Item 41

Corrosive Waste Pipe

Ceilcote Co. has announced the design and availability of a standard line of Duracor reinforced plastic corrosive waste pipe, claimed to have high strength, positive sealing, lower installed cost, and lasting corrosion resistance. Fabricated in ten-foot lengths to minimize troublesome joints, the pipe has bell-and-spigot construction. Joining on the job site with identical resins and random glass mat provides sealing.

Depending on surface traffic, the pipe can be encased in concrete, set in a concrete cradle and backfilled with sand, or laid on sand and backfilled with sand.

The company has also made available Duracor chlorine saturated brine headers in standard sizes. The headers are mandrel built from Duracor 6000-4 resin with wall thickness of 3/16 inch.

Readers' Service Item 42

Moisture-Proof Packages

Dry salad dressing mixes, one of the newest products of Schilling Division of McCormick & Co., Inc., are packaged in Metalam packets produced by Dobeckmun Co. Metalam, a special lamination of acetate, vinyl, and foil, provides not only excellent moisture protection, but attractive appearance for point-of-purchase displays.

The 3¾- by 5-inch packets are gravure-printed in seven colors. A Bartelt machine is used for the packaging operation and the packets are heat sealed.

Metalam packets are also used to package dry mixes for spaghetti sauce, minced onion, cheese dips, etc.

Readers' Service Item 43

Teflon Pipe Sealing Tape

Teflon tape for dry sealing all types of threaded pipe joints and threaded cable connectors is now available from Hitemp Wires, Inc. The tape eliminates the need for pastes and compounds in sealing pipe joints in hydraulic lines, compressed air lines, vacuum lines, steam lines, and corrosive chemical lines.

According to the manufacturer, the seal merely requires wrapping the tape around the pipe threads. No clean-up around the thread is necessary.

The tape, named Wrap-It, can be used on many materials. It is supplied in ½-inch widths and ten standard colors in 25-, 50-, and 75-yard sizes.

Readers' Service Item 44

Plastic Honeycomb Floors

The flooring of an experimental battlefield of the future consists of phenolic impregnated paper honeycomb. Several floors were recently delivered by Aeronutronic, who is developing the experiment for the U. S. Army Signal Corps, by Horkey-Moore Associates. The floors will be installed in the automated, mobile, electronic command system, which, known as Army Tactical Operations Central (ARTOC), will enable field commanders to have quick visual representations of tactical situations.

The plastic floor, measuring 231 by 288 inches, is made of eight, 130-pound panels of phenolic-paper honeycomb between two 0.020-inch sheets of aluminum. The finished floor can support up to 200 pounds per square foot.

Readers' Service Item 45

Pocket Water Purifier

The Purifilter, recently introduced by Sure Pure Co., Inc., makes the nearest body of water, be it a rain puddle, brook, or river, a source of potable, clean, sweet-smelling water. The unit comes in a compact, watertight kit, weighing only 15 ounces.

RONA™
SYNTHETIC
PEARL PIGMENTS
FOR COMPOUNDING INTO
- POLYETHYLENE
- POLYSTYRENE
- VINYL
- ACETATE
- NITRATE
- ACRYLICS
- CASEIN
- POLYESTERS
- PHENOLICS (CAST)
- ACRYLICS (CAST)
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and other resins

COATING ALL SURFACES

Rona Pearl Pigments are heat and light stable, non-reactive, non-corrosive, and impart high pearly luster, exceptional depth and brilliance at very lost cost.

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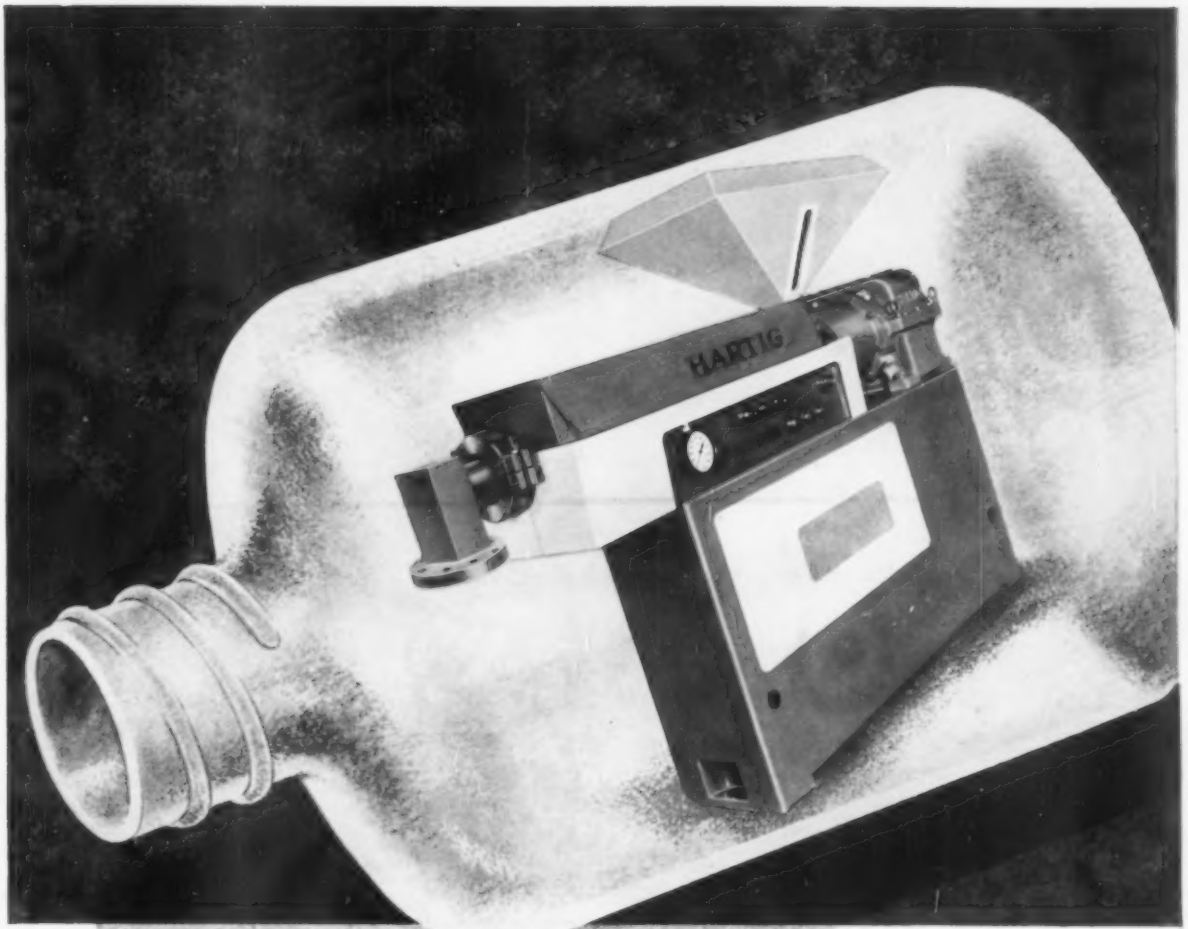

Big in BOTTLES!

More Hartig Extruders are used in blow molding bottles than any other make.

There are good reasons for **Hartig's** popularity—dependable performance—prompt service. Inherent in all **Hartig** machines is a technical competence in design and manufacture that pays off in performance.

Typical of the **Hartig** Extruders for blow molding installations is the 2½"—20:1 L/D ratio extruder shown. With flamehardened SAE 4140 steel feed screw in a centrifugally cast Xaloy lined barrel, this machine features a four zone heating system utilizing cast-in-aluminum heaters—3 on the barrel, 1 on the die.

You'll be interested in the new Waldron-Hartig Bulletin **LF-1** which gives the story on our laboratory facilities available for experimental and pilot plant studies. Write for your copy.

HARTIG EXTRUDERS

WALDRON-HARTIG DIVISION
Midland-Ross Corporation
P. O. Box 531 Westfield, N. J.

CANADIAN REPRESENTATIVE: Ross Engineering of Canada Ltd.
1669 Eglinton Ave. W., Toronto 10, Ontario

HE-960

EXTRUDERS • SPECIAL FEED SCREWS • MASTICATING HEADS • MANIFOLDS • DIES (ALL TYPES) • CONTROL PANELS • ACCESSORY EQUIPMENT

Portable Purifilter.

Water is siphoned from the source. It passes through a filtering-purifying element contained in a housing molded from a phenolic produced by Durez Plastics Division of Hooker Chemical Corp. The filter unit consists of a filter pad between two fiber screens. Compressing a rubber bulb built into the tubing supplied with the filter siphons water into and through the unit.

Water emerges without dirt or strong odors. An 0.86% of chlorine will be reduced to 0.17%. Accoding to tests, the filter will remove more than 190,000 bacteria, including 31,000 bacillus coli, per ml. Filter life is determined by the amount of clogging; only when no water can be forced through is it ready for replacement.

Readers' Service Item 46

When the problem is inorganic pigments and extenders for compounding plastics...

WILLIAMS *invites you to take advantage of its* **80 YEARS EXPERIENCE**

Today Williams offers a complete line of inorganic pigments and extenders for the plastics industry. All have color permanence and chemical stability. Here is a representative list of these products.

Pure Red Iron Oxides • Pure Yellow Iron Oxides • Pure Black Iron Oxides • Pure Brown Iron Oxides • Pure Chromium Oxide Greens • Pure Hydrated Chromium Oxides • Umbers • Siennas • Lampblack • Anhydrous Calcium Sulfate • Barytes • Calcium Carbonates

Send today for detailed Technical Reports which give you complete description of the chemical and physical properties of each. Address Department 37, C. K. Williams & Co., 640 N. 13th Street, Easton, Pennsylvania.

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COLORS & PIGMENTS
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E. St. Louis, Illinois • Easton, Pennsylvania • Emeryville, California

20 Mule Team soap dispenser.

Institutional Soap Dispenser

A redesigned soap dispenser is being sold nationally by 20 Mule Team Products, U. S. Borax and Chemical Corp. Designed by Walter Landor and Associates, it is claimed to be the first plastic and metal soap dispenser designed for use in factories, shops, offices, schools, etc. Among its advantages is a plunger which can adjust the amount of soap ejected.

Although intended for powdered soap, the dispenser can be adapted for liquids. Filled with powdered soap, the model may dispense up to 5,000 strokes of soap before refilling is necessary. Standard colors are bronze and grey; others are available in lots of 500.

The inside unit is injection molded of Styron 475, high impact polystyrene made by Dow Chemical Co., by B-W Molded Products. The styrene was chosen instead of metal because of its stability and attractiveness.

Readers' Service Item 47

Celanese containers.

Blow Molded PE Bottles

Celanese Plastics Co. has made available a line of blow molded polyethylene bottles for industrial and home uses. Manufactured by the Royal Container Department and known as the Royal Designer Line, the bottles come in 12, 22, and 32 ounce sizes.

The resin for pressing problems, impressing customers

Resin-rich areas are controlled; excellent "hot strength" prevents fracturing of products during demolding; and surface gloss is good.

A fast-curing GLIDPOL® isophathalic-based polyester resin system specifically formulated for matched die molding provides these advantages for the high rate production of all types of containers, hoppers, tote boxes, trays and many other products.

Write for details on how this semirigid GLIDPOL polyester resin system can help you mold better reinforced plastic products . . . mold them faster and more economically.

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There's a GLIDPOL polyester resin system, plus Glidden Technical Service, to help you do it better, more economically, whatever your product, process or problem.

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For a Whole Family of Vinyl Products

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EPOXIDIZED PLASTICIZER-STABILIZERS

PEROXIDOL 780 is the lowest cost vinyl plasticizer-stabilizer sanctioned by the FDA for vinyl systems used in food packaging.

PEROXIDOL 781 has important properties for a wide variety of vinyl products; it offers excellent low temperature flexibility and viscosity stability.

These epoxidized plasticizer-stabilizers, with their optimum oxirane content and iodine value, will provide vinyl products with increased resistance to heat, light, weathering and water extraction. Their good wetting properties and low volatility assure speed in processing.

Every processor will be interested in *all the facts* about the economy, convenience and performance of RCI PEROXIDOLS. Write for full technical data today.

Creative Chemistry ... Your Partner in Progress

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Synthetic Resins • Chemical Colors • Industrial Adhesives • Phenol
Hydrochloric Acid • Formaldehyde • Phthalic Anhydride
Maleic Anhydride • Ortho-Phenylphenol • Sodium Sulfite
Pentaerythritol • Pentachlorophenol • Sodium Pentachlorophenate
Sulfuric Acid • Methanol

REICHHOLD CHEMICALS, INC.,
RCI BUILDING, WHITE PLAINS, N. Y.

Extended rings prevent paper labels from slipping. However, they can also be labeled by decal, offset, and silk screen.

Readers' Service Item 48

PE Hot Drink Cup

An attractive beaker with holder set has been introduced by Mendle Bros. Ltd. Molded in Rigidex High density polyethylene, it is primarily intended for serving hot drinks. It is particularly useful wherever there is a risk of marking table tops or other polished surfaces, the holder being designed to provide a small air space beneath the tumbler to prevent contact with furniture.

High density polyethylene beaker and holder.

The beaker, which holds one-half pint, will not soften in boiling water. The lip is easy to drink from, without dribbling or spilling.

Readers' Service Item 49

Plastic Lenses

Fostoria Corp. is producing optically ground and polished plastic lenses in several sizes, shapes, and types. Advantages over glass claimed for the lenses include low cost, light weight, relative lack of distortion, resistance to chipping and breakage, and ease of machining. In addition, they transmit up to 7% more light than glass lenses of the same thickness.

All types, including optically ground solid, molded, and lenticular lenses, are available. Fresnel, aspheric, and other specialized lenses will be fabricated to specifications.

Readers' Service Item 50

FOR EVERY POLYURETHANE FOAM PROCESS, THERE'S A UNION CARBIDE SILICONE SURFACTANT

Check Here

☐ **One shot, water blown flexible polyether** foam requires 0.3 to 0.8% of UNION CARBIDE Surfactant L-520. No other surfactant gives the good stable rise, open cells and fine pores so necessary for high quality use such as cushioning.

☐ **One shot, fluorocarbon blown flexible polyether** foam for extra soft pillows is almost impossible without UNION CARBIDE Surfactant L-520. Gives a good stable rise, too. Concentrations up to 1.5%.

☐ **One shot, rigid polyester** foam, such as used for structural purposes, has virtually 100% closed cells with only 0.1 to 0.5% of XL-521.

☐ **Prepolymer, flexible polyether** foam has 85% open cells, uniform structure when 10 or 50 cstk. UNION CARBIDE L-45 is used.

☐ **Prepolymer, semi-rigid polyether** foam, such as required in crash-pad applications, is best made with about 1 to 2% of UNION CARBIDE LE-452 metered in at the foam machine.

☐ **Prepolymer, fluorocarbon blown rigid polyester** foam, of the type used in refrigerator insulation, is 90% closed cells, has good rise and fine pores if made using between 0.1 and 0.5% of UNION CARBIDE XL-521 added to the prepolymer side. Closed cells hold fluorocarbon gas for low thermal conductivity.

LIKE TO KNOW MORE? Samples of these special silicone surfactants and Silicones Man technical aid from Dept. KN-4902, Silicones Division, Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *(In Canada:* Union Carbide Canada Limited, Toronto 12.)

Unlocking the secrets of silicones

Rubber, Monomers, Resins, Oils and Emulsions

UNION CARBIDE SILICONES

The term "Union Carbide" is a registered trade mark of UCC.

New Literature

For more information check Readers' Service Card (p. 89)

"Give Appliances That Extra Edge for Extra Sales." Dow Corning Corp. 8 pages. Suggestions for using silicones to provide electrical reliability, mechanical dependability, and maintenance-free service in consumer goods are provided. Describes appliance applications of silicone rubber, paints, fluids, lubricants, and electrical insulation.

Readers' Service Item 61

"Preliminary Information about Tenite Polypropylene." Eastman Chemical Products, Inc. 4 pages. Molding and extrusion characteristics; physical, mechanical, electrical, and other properties. Conditions for molding and extrusion.

Readers' Service Item 62

"Tubing Tools." Catalog No. 3121. Imperial Brass Mfg. Co. 32 pages. Shows tools and kits for all tubing work in such fields as maintenance, instrumentation, plumbing, and heating. Replacement parts and federal specifications are listed.

Readers' Service Item 63

"Sonoray Ultrasonic Flaw Detector." Bulletin T200. Branson Instruments, Inc. 8 pages. Operation, techniques, and specification of the Sonoray 5 flaw detector, a pulse-echo instrument with low frequency resolving power and penetration.

Readers' Service Item 64

"Thymotrol Speed Variator." Bulletin GEA-7018. General Electric Co. 8 pages. Adjustable speed drive uses the Thyratron tube to convert a-c to d-c power. Information and data on general purpose drives, including details of standard and optional features, are contained in the booklet.

Readers' Service Item 65

"Plastic Extrusions." Bulletin 110. Jessall Plastics, division of Electric Storage Battery Co. 12 pages. The bulletin illustrates Jessall extrusions (large-diameter rigid tubing, custom rod and tubing, custom profiles, and Strip-a-Tube) and typical applications. It includes a table of physical and chemical properties of thermoplastic compounds.

Readers' Service Item 66

"HET Acid for Paints, Coatings, and Other Applications." Bulletin No. 40-A. Hooker Chemical Corp. 12 pages. This chemical, as a dibasic acid possessing over 54% of its weight of stable chlorine, is recommended for making chlorine-containing resins products with a high degree of fire resistance. It is said to provide unique solubility characteristics which promote ease of reaction in synthesizing a wide range of substances. Products made from it are reportedly characterized by fire resistance, oil solubility, hardness, gloss, heat stability, water repellency, and adhesion.

Readers' Service Item 67

"Single Spindle Painting Machine." Conforming Matrix Corp. 2 pages. Model SS2G, a portable, air-motivated machine, is equipped with two automatic spray guns and an automatic timing device. Variable speed drive of the spindle is 100-400 rpm.

Readers' Service Item 68

"Barrel and Vibratory Finishing." Bulletin No. 901. Lord Chemical Corp. 4 pages. Specification of Lorco media and compounds for barrel and vibratory finishing are presented. Issued with the bulletin is a specification sheet on Techline liquid abrasives for wet blasting.

Readers' Service Item 69

"Power Feed Drill Presses." Bulletin 100M. Rockwell Manufacturing Co., Delta Power Tool Division. 12 pages. The line of Delta 20-inch power feed drill presses, combining front control with one-hand operation, is described. The presses are available in 18 models.

Readers' Service Item 70

"Case Histories of Performance." Bulletin No. 1000. National Automatic Tool Co., Inc. 12 pages. Natco injection molding machines are illustrated in action at molding plants. Some specifications are listed.

Readers' Service Item 71

"Stepless Variable Speed Drives." Catalog ZM-400C560. Zero-Max Co. 16 pages. Details on all units, with or without motor, in the 400 series of Zero-Max variable speed drives for fractional horsepower applications are presented in charts, diagrams, and text. Typical applications are pictured.

Readers' Service Item 72

"Rigid Unplasticized Polyvinyl Chloride Pipe & Fittings." Glamorgan Plastics Division, Glamorgan Pipe & Foundry Co. 56 pages. Applications, specifications, properties, and methods of installation.

Readers' Service Item 73

"Condensed Catalog." Sarco Co., Inc. 12 pages. Technical details, dimensions, and capacity data on the most widely used devices in the Sarco line of steam traps, temperature regulators, and heating specialties.

Readers' Service Item 74

"How to Machine Glass Base Laminated Plastics." National Vulcanized Fibre Co. 4 pages. The article describes techniques, tooling needs, and recommended set-up practices for fabricating these materials. Included are sawing, shearing, slitting, punching, drilling, tapping and threading, turning, boring, facing, and milling.

Readers' Service Item 75

"Industrial Water Consulting Service." Hall Laboratories, Division of Hagan Chemicals & Controls, Inc. 24 pages. The range of industrial water problems and the necessity for proper water management to obtain lowest water costs are discussed. Examples of lowered water costs are highlighted.

Readers' Service Item 76

"Resistance of Rigidex Polyethylene Bottles to Various Detergents." Tech. Note No. R203. British Resin Products Ltd. 6 pages. A series of tests, during which five detergents were stored in polyethylene bottles at two temperatures, showed that Rigidex Type 3 (density 0.95, melt index 0.3) had the greatest crack resistance. The effect of providing bottles with vented stoppers is also described.

Readers' Service Item 77

"List of Commercial Standards." Catalog No. 978. Commodity Standards Division, Office of Technical Services, U. S. Department of Commerce. 12 pages. Commercial standards in 22 classifications are listed, with prices. Standards in preparation and under revision are shown in a supplement. Also available is a pamphlet entitled "Commodity Standards, What They Are—How They Are Done—Why They Are Used."

Readers' Service Item 78

"Chemical Division Product Directory." Goodyear Tire & Rubber Co. 12 pages. Catalog of rubber and rubber chemicals, adhesives, coatings, vinyls, and polyesters. Information is tabulated as to color and form, description, inherent viscosity, specific gravity, particle size, bulk density, packaging unit, and application.

Readers' Service Item 79

"Physical and Performance Properties of the Monoplex and Paraplex Plasticizers." MR-20-60. Rohm & Haas Co. 24 pages. The booklet outlines performance properties versus plasticizer concentration of PVC stocks, plasticizer requirements for typical end products, and physical properties of neat plasticizers.

Readers' Service Item 80

Book Reviews

"Source Book of the New Plastics." Volume 1. Herbert R. Simonds. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth, 6¼ by 9¼ inches, 354 pages. $10.00.

The author of a survey of recent innovations and developments must overcome an inherent disadvantage: what might have been regarded as new when the book was in manuscript is often old hat by the time of publication. News of materials and techniques is, therefore, often more adaptable to magazine rather than book publishing. The sole advantage of the hard-cover treatment might be that the format and organization permit an overview unattainable when the materials are merely examined individually.

Mr. Simonds has compiled the book from information submitted by primary and secondary material suppliers. Individual chapters, contributed to companies, are arranged in alphabetical order by contributor. Therefore, to survey developments in polyethylene, for example, the reader must refer to the index and flip through to the appropriate pages. Unless the reader is primarily interested in activities within companies, the book is rather cumbersome to use.

For the most important new materials, such as polypropylene, acetal resin, polycarbonate, and methylstyrene, detailed processing information and physical property data are included. In general, though, material is rather sketchy; in many instances only a paragraph is devoted to a series of materials. Since the book often duplicates manufacturers' literature, the reader, for no charge, will usually be able to acquire the same or more up-to-date information on his own.

In addition to the major section on producers' new materials, there are brief surveys of federal-sponsored research and improvements in established materials.

"The Chemistry of Industrial Toxicology." Second Edition. Hervey B. Elkins. John Wiley & Sons, Inc., 440 Park Ave. S., New York 16, N. Y. Cloth, 6 by 9¼ inches, 452 pages. $11.50.

Since this volume was written for the engineer and chemist, rather than the physician, it emphasizes harmful substances and the processes in which they are used, rather than their effects on human beings. It is concerned with the nature of toxic substances, determination of concentrations and degrees of toxicity, and prevention of disease through effective disposal of vapors and dust.

Approximately one-half of the book is devoted to a systematic survey of the harmful effects, maximum allowable concentrations, and evaluations of chemical substances. Arranged within the categories of elements, inorganic compounds, or organic compounds, common and some not-so-common substances are discussed. Wherever possible, Dr. Elkins has documented his evaluations about the chemicals with references to scientific studies. His comparisons of the toxicity of related compounds useful for similar purposes are also helpful.

The remainder of the book covers, in general, toxic materials by industrial process and analytical methods and procedures for quantitative and qualitative determinations.

"Compilation of Standards: Rubber Products, D-11." American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Cloth, 6 by 9 inches, 1028 pages. Price, $9.75.

This nineteenth edition of the D-11 compilation on rubber and rubber-like materials contains 163 standards, 22 of which are new and 66 of which are revised or changed in status since the preceding May 1958 edition.

Among the new standards are several covering cellular materials of PVC or copolymers and urethane foam, two on the effects of radiation, and several on carbon black.

"World Survey of Plastics—1954-1957." Business and Defense Services Administration, U. S. Department of Commerce, Washington 25, D. C. Paper, 7¾ by 10¼ inches, 168 pages. $1.00.

This survey attempts to present as much information on the plastics industry in the United States and 53 other countries as is statistically available. Brief coverage on Soviet plastics activity is supplied, but the Soviet bloc countries are not included because of lack of obtainable data.

The publication deals primarily with plastics materials (excluding natural resins, synthetic fibers, and rubber), but plastics products are briefly treated. Topics covered include production, consumption, imports, exports, distribution and marketing, trade promotion, and equipment for processing plastics materials. Prospects for increasing United States participation in foreign markets are also analyzed.

Limitations in the availability of statistical data on plastics has, in many cases, resulted in less adequate coverage than would have been desirable. For many countries, data on the production of and foreign trade in plastics materials are incomplete or not broken down according to types.

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HYDRAULIC
MOLDING PRESSES
Complete Line 10 To 300 Tons
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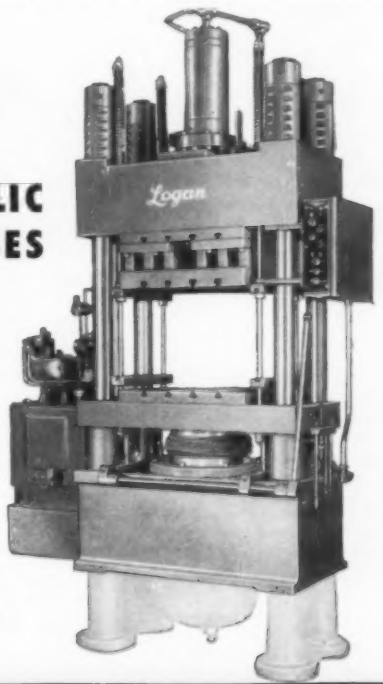
- Self-Contained
- Fast Cycling
- Full Controls
- Accurate
- Economical



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Patent Digest

Materials

Moldable Polyethylene. No. 2,919,474. Q. P. Cole, Pittsfield, Mass. (to General Electric Co.).

Internally Plasticized Melamine Resins. No. 2,916,410. G. L. Fraser, Wilbraham, and C. Elmer, Springfield, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Machine for Rolling Plastic Strips. No. 2,919,468. I. Spinner, Chicago, Ill.

Apparatus for Injection Molding. No. 2,919,469. R. T. Wheeler, Normandy, Mo. (to Crown Cork & Seal Co., Inc., Baltimore, Md.).

Cellular Polyurethane Resins and Preparation of Same. No. 2,924,581. A. Bavley, Brooklyn, C. J. Knuth, Flushing, and A. E. Timreck, Forest Hills, N. Y. (to Chas. Pfizer & Co., Inc., New York, N. Y.).

Polyethylene Blend. No. 2,924,559. M. M. Safford, Schenectady, and R. L. Myers, Ballston Lake, N. Y. (to General Electric Co.).

Plastic Blends Comprising Resinous Copolymer of an Aryl Monomer and an Acidic Monomer, and a Graft Copolymer of Polybutadiene, Aryl Monomer and Acidic Monomer. No. 2,927,095. H. S. Witt, E. Paterson, N. J. (to U. S. Rubber Co., New York, N. Y.).

Redox Resins. No. 2,927,096. S. Soloway, New Rochelle, N. Y.

Molding Composition Comprising Ethyl Cellulose, Epoxy Compound and Phenolic Compound and Process of Preparing. No. 2,928,795. J. S. Tinsley, New Brunswick, N. J. (to Hercules Powder Co., Wilmington, Del.).

Polyethylene Composition Containing Di-α-Cumyl Peroxide, Silica, and a Stabilizer, and Process of Making Same. No. 2,928,801. M. M. Safford, Schenectady, N. Y., and M. L. Corrin, Tucson, Ariz. (to General Electric Co.).

Blend of Synthetic Resinous Copolymer and Rubbery Materials. No. 2,929,795. R. J. Reid, Canal Fulton, and W. R. Conard, Kent, O. (to Firestone Tire & Rubber Co., Akron, O.).

Flame Retardant Polyester Resin Composition Containing Halogen and Phosphorus, and Laminated Article Using Said Composition as a Binder. No. 2,931,746. P. Robitschek, Wilson, and C. T. Bean, Niagara Falls, N. Y. (to Hooker Chemical Corp., Niagara Falls, N. Y.).

Polyethylene Compositions Containing 2,4,4'-Trihydroxybenzophenone, No. 2,925,401. G. C. Newland, J. W. Tamblyn, and C. J. Kibler, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Linear Polyesters Containing an Alkylene Diamine Group and Manufacture Thereof. No. 2,925,405. T. M. Laakso and J. L. R. Williams, Rochester, N. Y. (to Eastman Kodak Co., Rochester, N. Y.).

Thermal Stabilization of Haloethylene Polymers. No. 2,926,152. D. A. Gordon, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Polystyrene Phonograph Record Compositions. No. 2,927,092. E. A. Naudain, Newark, Del. and A. L. Rummelsburg, Chadds Ford, Pa. (to Hercules Powder Co., Wilmington, Del.).

Composition Comprising Vinyl Chloride Resin, Copolymer of Butadiene and Acrylonitrile, and the Product made by Polymerizing Butadiene in the Presence of a Copolymer of Acrylonitrile and Styrene No. 2,927,093. W. M. Germon, Cuyahoga Falls, O. (to Goodyear Tire & Rubber Co., Akron, O.).

Resins from Epoxidized Liquid Diene Polymers and Phenol Aldehyde Resins and Method of Making Same. No., 2,927,094. C. E. Wheelock, Bartlesville, Okla. (to Phillips Petroleum Co.).

Composition Comprising Polyethylene and an Ethylenically Unsaturated Aliphatic Hydrocarbon of 20-35 Carbon Atoms and Article Thereof. No. 2,924,584. L. E. Wolinski, Buffalo, N. Y. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Prices, 25c each.
—The Editor

Vinyl Chloride Resin Compositions, Stabilized and Plasticized with Epoxy Compounds. Nos. 2,924,582 and 2,924,583. (to Union Carbide Corp.).

Polymer Composition Comprising a Resinous Polymer and the Salt Obtained by Reacting a Quaternary Ammonium Compound with an Anionic Surface Active Compound and Method of Making Same. No. 2,925,397. K. Hopfner and W. Offermann, Dusseldorf, Germany (to Dehydag, Deutsche Hydrierwerke G.m.b.H., Dusseldorf, Germany).

Linear Polyesters of Mercaptodicarboxylic Acids, Polymers Prepared Therefrom, and Method of Making Same. No. 2,924,585. J. V. Schmitz, Fullerton, Calif. (to General Electric Co.).

Coated Polyethylene and Process of making Same. No. 2,925,354. F. M. Berardinelli, S. Orange, and J. S. Shanly, New Providence, N. J. (to Celanese Corp. of America, New York, N. Y.).

Composition Comprising Solid Polyolefin and a Hydrogenated Polyphenyl. No. 2,925,398. A. Y. Coran, Brentwood, and H. L. Merten, Glendale, Mo. (to Monsanto Chemical Co., St. Louis, Mo.).

Thermoplastic Films Coated with Vinylidene Chloride Copolymer and an Antistatic Agent. No. 2,925,356. D. I. Sapper, Cheektowaga, N. Y. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Composition Comprising a Mixture of an Elastomeric Copolymer of Butadiene and a Thermoplastic Copolymer of Styrene and Acrylonitrile and Process for Producing Same. No. 2,925,399. P. Schneider, Opladen, G. Scriba, Leverkusen-Wiesdorf, and W. Graulich, Leverkusen-Bayerwerk, Germany (to Farbenfabriken Bayer AG., Leverkusen, Germany)

Poly-α-Olefins Stabilized with Long Chain Alkyl Gallates. No. 2,925,400. C. E. Tholstrup and A. Bell, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Equipment

Vinylidene Polymer Composition Containing Ammonium Salt of a Totally Hy-

droxylated Amine. No. 2,922,770. Composition of Matter Comprising Polystyrene and Carboxyalkylated Polyamines. No. 2,922,771. Molding Compositions of Vinylidene Resin Polymers and Quaternary Ammonium Destaticizing Compounds. No. 2,922,772. Non-Electrostatic Vinylidene Polymer Molding Compositions Destaticized with Alkylene Oxide-Alkylene Diamine Condensation Product. No. 2,922,773. M. A. Coler, Scarsdale, and A. S. Louis, Riverdale, N. Y.

Method of and Means for Forming Hollow Articles. No. 2,930,079. F. T. Parfrey, Hughesdale, near Melbourne, Victoria, Australia.

Thermoplastic Mixture of Butadiene-Acrylonitrile Rubber, Styrene-Acrylonitrile Resin, and Vinyl Chloride Resin. No. 2,924,545. L. E. Daly, Mishawaka, Ind. (to U. S. Rubber Co., New York, N. Y.).

Thermoplastic Compositions Having Improved Stability to Heat and Light. No. 2,922,777. B. E. Burgert and D. A. Gordon, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Stabilization of Vinyl Alkyl Ether Resins. No. 2,922,778. H. M. Rife and A. H. Walker, Charleston, W. Va. (to Union Carbide Corp.).

Epoxy Resins Plasticized with Di-(Butoxyethyl)Adipate. No. 2,923,695. F. P. Greenspan, Buffalo, and R. E. Light, Jr., Kenmore, N. Y. (to Food Machinery and Chemical Corp., San Jose, Calif.).

Resinous Flameproofing Composition. No. 2,924,532. J. E. Dereich, Painesville, O. (to Diamond Alkali Co., Cleveland, O.).

Embossing Method and Apparatus. No. 2,928,124. R. H. Hugger, Ridgewood, N. J. (to U.S. Rubber Co., New York, N. Y.).

Method of and Injection Nozzle for Preventing Excessive Heat Transfer to a Mold. No. 2,928,125. R. E. Smucker and J. M. Harrison, Fort Worth, Tex. (to Crown Machine and Tool Co., Fort Worth, Tex.).

Apparatus for Dividing by Volume Plastic Materials. No. 2,928,172. Print Molder for Plastic Materials. No. 2,928,-173. T. L. A. M. Steenhuis, Kleve, Germany (to Lever Brothers Co., New York, N. Y.).

TENITE DEVELOPMENT LABORATORY
DOINGS AND FINDINGS

HAPPY HOME

Have you noticed what today's improved milk cartons are doing for the home? Modern cartons of polyethylene-coated paper allow Mother to do the shopping with less worry about milk leaking over other groceries. And Dad—well, we all know who takes out the garbage. And toting a bag not previously weakened by milk leakage does to some extent brighten his day.

With the many improvements that have been made in resins used for the extrusion-coating of paper, cartons are now more dependable than they have ever been before. With Eastman's new Tenite Polyethylene 895P-6000 Natural, for example, pinhole-free coatings have been produced at weights just above 7½ pounds per ream (about 0.5 mil). This resin—melt index 3.5 and nominal density 0.921—offers superior and uniform drawdown properties that will, in fact, permit coatings as thin as 3 pounds per ream (about 0.2 mil). Paper coaters have found it to be excellent for a wide range of coating weights.

More information is available in our Materials Bulletin 2 if you're interested.

A MATTER OF CHOICE

Both acetate and butyrate sheet are extensively used for blister, bubble, and skin packaging. Butyrate usually gets the nod when extra strength and longer shelf-life are primary requirements. Acetate—costing a bit less—meets less stringent packaging needs very satisfactorily. Eastman's technologists have developed a new formulation, Tenite Acetate 081, for the extrusion of thin-gauge sheet which makes the forming of extremely clear, deep bubbles and blisters wellnigh a cinch. In thermoformed packaging, the sheet permits deep draws without blushing.

Whichever you prefer . . . acetate or butyrate . . . you can count on high quality in these Tenite plastics. If you're uncertain which material is better for your purpose, just ask and we'll help you find out.

ALL BECAUSE OF A TEAR-TAPE

The next time you remove the top of a wrapper from a box of cough drops or a pack of cigarettes, notice how easily and smoothly the tear-tape works. Probably you've never given much thought to such an everyday convenience. Neither had we, until we began studying the possibilities of inexpensive polyethylene film as an overwrap material. Shortly thereafter, tear-tape operation became something of a hair-tearing preoccupation.

In development work with a standard high-speed cigarette overwrap machine, we found that polyethylene film could

be rapidly and smoothly overwrapped with only minor changes in the equipment. The most important machine modification arose in connection with sealing. Heated Teflon-coated rollers proved to work out nicely in producing clear, even seals.

The biggest problem, it turned out, lay not in applying the film overwrap but, rather, in opening the wrapped package by means of tear-tape. Being naturally tough, polyethylene film tore irregularly when the tape was pulled. We tried orienting the film. That helped, but not enough. To lick the problem thoroughly, our plastics laboratories took definitive action . . . they handily developed a new Tenite polyethylene formulation with the special tear characteristics needed. Tailored to a tear-tape, you might say.

For more information or for answers to any questions about the fabrication or use of Tenite plastics . . . polyethylene, polypropylene, butyrate, acetate, propionate, and polyester . . . contact either your nearest Tenite representative or Eastman Chemical Products, Inc., Plastics Division, Kingsport, Tennessee.

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Article Abstracts

Materials

"The Building-Up and Properties of Cross-Linked, Highly Elastic, Rigid Plastics," E. Muller, KUNSTOFFE, 50, 8, 437 (Aug. 1960).

By reacting high molecular linear hydroxyl compounds with excess diisocyanates and chain extenders such as glycols, cross-linked products possessing excellent rigidity and hardness and high rebound elasticity are obtained. The properties are determined by the reaction effect of the two segments in the cross-linked macromolecule.

"Stereospecific Polymers," W. Cooper, RUBBER & PLASTICS AGE, 41, 8, 910 (Aug. 1960).

A brief report on the papers presented at the Macromolecular Conference in Moscow this year.

"The Physical and Chemical Investigation of Fiber Reinforced Plastics," H. Hagedorn, KUNSTSTOFFE, 50, 8, 442 (Aug. 1960).

A review of the papers given at the SPI Reinforced Plastics Division conference early this year.

"A New Pigment for Electrically Conducting Lacquers Applied to Plastics Surfaces," KUNSTSTOFFE, 50, 8, 478 (Aug. 1960).

By means of a new type of metallic pigment, it is possible to produce lacquers which are electrically conducting and, therefore, may be used to coat plastics surfaces with a conductive finish.

"Calculation of Amount of Filler, Specific Weight and Cost of Castings and Moldings Based on Casting Resin Compounds," A. Rost, KUNSTSTOFFE, 50, 8, 473 (Aug. 1960).

Casting resins are only rarely used in the clear state. Fillers are almost always added, such as glass fiber in the case of laminates and quartz flour in the case of castings. The amount of filler present influences the properties of the finished product, as well as its cost.

"Structure and Formation of Plastisols," E. G. Curphy, PLASTICS, 25, 267, 28 (Jan. 1960).

Thermodynamics of the solvation of polymer particles, steric influences on polymer/plasticizer relations, dependence of fusion temperature and viscosity of plastisols, and agglomeration effects are discussed. The presence of an epoxy group improves compatibility of plasticizers with PVC resins.

"Plastics Rolled Up According to Weight," H. Gut, KUNSTSTOFFE, 50, 8, 475 (Aug. 1960).

If one knows the weight per surface area and the width of the plastics sheeting, it is possible to arrive at a relationship between the height of winding and the weight of the roll.

"Hardeners for Epoxy Resins," C. S. Hardo and B. O. Schoeple, SPE J., 16, 8, 953 (Aug. 1960).

A discussion of low-melting HET-Hexahydrophthalic Anhydride mixtures as a new system for making fire-resistant epoxy resins.

"Synthetic Polymers: The Great Benefactors of the Mankind," K. N. Sanyal, INDIAN PLASTICS REV., 3, 9 (March 1960).

A brief review of plastics and their uses in daily life, electronics, industry, engineering and commerce.

"Properties of Nylon 11," J. G. Hawkins, PLASTICS (LONDON), 25, 274, 299 (Aug. 1960).

The physical, mechanical, electrical, and chemical properties of Ralsin, the nylon 11 resin manufactured in France by Organico.

"The Chemistry and Application of Rug-Backing Compounds," George Brawner, APPLIED PLASTICS, 3, 8, 41 (Aug. 1960).

A non-technical review of applications for these materials.

"The Separations of Plasticizers from PVC Compositions," M. W. Robertson and R. M. Rowley, BRIT. PLASTICS, 33, 1, 26 (Jan. 1960).

A constant boiling mixture of carbon tetrachloride and methanol gave satisfactory results for extracting residual plasticizer, after eight hours of ether extraction, from several commercial PVC compositions. Exceptions were blends of butadiene/acrylonitrile copolymers and low molecular PVC; and vinyl chloride/vinyl acetate copolymers.

"Plastics and Rubbers under Extreme Operating Conditions," E. W. Russell, TRANS. PLASTICS INST., 28, No. 76, pp.164 (Aug. 1960).

The behavior of reinforced plastics under high stress is discussed in relation to the properties of their components. The effects of tropical aging and of reactive chemical environments on rubbers and plastics are briefly considered.

"Molding for Maximum Impact Strength," J. N. Scott, D. M. Jones, and P. J. Boeke, MODERN PLASTICS, 38, 1, 131 (Sept. 1960).

How to mold the high melt index, high density polyethylenes to produce the toughest product at a lower cost.

"Defects in Glass Fibers and their Effect on the Strength of Plastic Moldings," N. J. Parratt, RUBBER & PLASTICS AGE, 41, 3, 263 (March 1960).

The reinforcing strength obtained from a fiber of given diameter is shown to be dependent on the strength of a certain critical fiber length.

"Auxiliary Materials for Polymethylmethacrylate," T. Perotti, MATERIE PLASTICHE, 26, 4, 326 (April 1960).

Discussion of anti-static agents, pigments and colors, adhesives for components of the resin, and inks and varnishes for decoration. (In Italian).

"Contributions to Analytical Chemistry of Plastics XI. Determination of Plasticizers in the Production of Cellulose Hydrate Film," E. Schroder, PLASTE U. KAUTSCHUK, 7, 4, 167 (April 1960).

Formula for the quantitative and qualitative determination of plasticizers in cellulose hydrate are derived.

"New Methods of Testing PVC for Paste-Forming Qualities," F. Bohme and K. Muller, PLASTE U. KAUTSCHUK, 7, 3, 124 (March 1960).

Tests were conducted to determine the stability of PVC dispersions in DOP. Structure and properties of suitable polymers are cited. (In German).

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in February. The last listing appeared in the October issue.

"New Epoxides for Plastics and Coatings," G. A. Trigaux, MODERN PLASTICS, 38, 1, 147 (Sept. 1960).

Four cycloaliphatic diepoxides are shown to be important new additions to the epoxy family.

"Epoxide Resins," M. Marozeau, L'OFFICIEL MATIERES PLASTIQUES, 7, 71, 70 (June 1960).

Main properties and applications of epoxy resins. (In French).

"Measuring the Compressibility of High Polymers in Relation to Pressure," K. Krober, PLASTE U. KAUTSCHUK, 7, 3, 128 (March 1960).

Linear compressibility as a function of hydrostatic pressure was measured at room temperature. Testers and calculations are explained. (In German).

"The Aging Mechanism of VC Under the Influence of Light and Heat," A. Cittadini and R. Paolillo, MATERIE PLASTICHE, 4, 31 4(April 1960).

Current opinions and probable mechanisms of light and heat decomposition and degradation are reviewed. (In Italian).

"Knowledge of Polyesteramides II: Copolycondensation of Terephthalic Acid Diols and Alkanolamines," K. Thinius and K. H. Wingerter, PLASTE U. KAUTSCHUK, 7, 2, 78 (Feb. 1960).

Methods of preparing copolycondensates from terephthalic acid, diols, and alkanolamines. Oligomers, particularly oligomericamido propylene terephthalate wtih oligomeric ethylene terephthalate, yielded the best results. (In German).

"Explanation of Strength Decrease of Heat Sealed Plastic Sheeting," H. Frielingsdorf, K. Becker and R. Heiss, KUNSTSTOFFE, 50, 3, 148 (March 1960).

Determination of the causes for failure in welded seams in practice.

"Preparation and Application of Furan Resins from Furfuryl Alcohol," H. Kaesmacher, KUNSTSTOFF-RUNDSCHAU, Part I, 7, 2, 77; Part II, 7, 3, 117 (Feb. and March 1960).

Part I—fundamentals of resin formation and cures. Part II—optimum conditions for producing resins of uniform molecule size; structure of resins; reactions during formation. (In German).

"Research Data and Problems on the Behaviour of Plastics Exposed to Weathering," P. Dubois, IND. PLASTIQUES MOD., 11, 11, 13; 12, 1, 7; 12, 2, 61 (Dec. 1959; Jan.-Feb. 1960; March 1960).

Internal and external factors in aging of plastics. Correlations between the results of natural and artificial aging are doubtful or non-existent in two-thirds of the cases. (In French).

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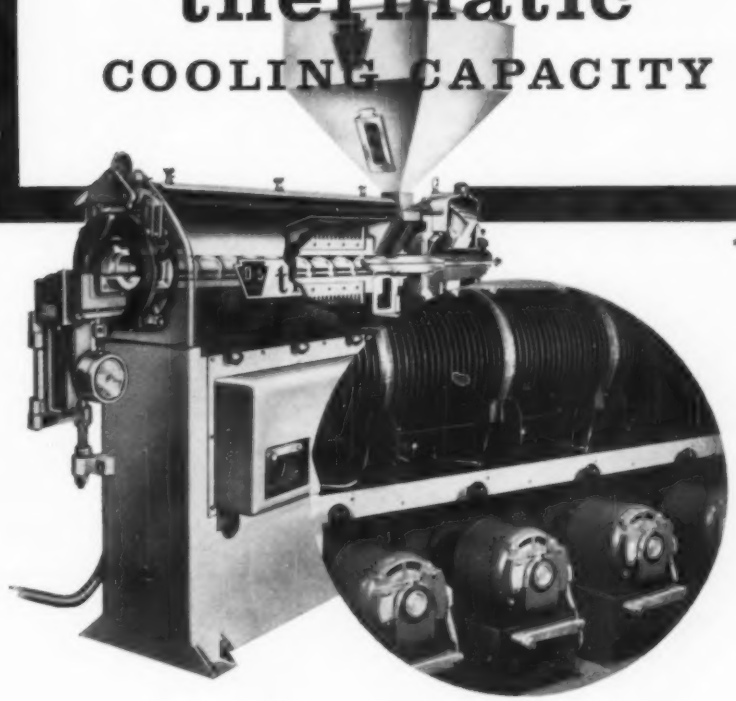

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"Low Pressure Pipe for Drinking Water," K. Richard, E. Gaube, and G. Diedrich, KUNSTSTOFFE, 49, 10, 516 (Oct. 1959).

Investigations of the various factors influencing long-term behavior of plastics pipe for conveying drinking water have been conducted for several years now. The present article summarizes and discusses work reported in earlier issues on determination of values for creep elongation limit and creep rupture strength, calculation of permissible stresses, wall thickness, safety factors, and quality tests for Ziegler-type polyethylene pipe. (In German.)

"Investigations into the Strength of H.F. Welded Seams in PVC Sheeting," S. Wintergerst, KUNSTSTOFFE, 50, 3, 145 (March 1960).

This paper investigates the influence on seam strength of plasticizer content, sheeting thickness, welding pressure, and size and shape of welding electrodes.

"The 300° F. Exotherm Curve — A Molding Resin Selector," B. D. Martin and Arthur Weber, PLASTICS WORLD, 18, 7, 20 (Aug. 1960).

A brief discussion of a modified method for running standard 180° F. tests in for use in resin development, selection, and control.

"Cold-Formed Polycarbonate Resin," Geza Gruenwald, MODERN PLASTICS, 38, 1, 137 (Sept. 1960).

A report on the processing techniques, physical properties of finished products, and the areas of application.

"Some Aspects of the Degradation and Stabilization of Polyvinyl Chloride," D. K. Taylor, TRANS. PLASTICS INST., 28, No. 76, pp. 170 (Aug. 1960).

Current views of the degradation mechanism of PVC are reviewed in the light of methods for stabilizing the commercial product. Experimental details are given the effects of some special stabilizing compositions, and the results obtained are discussed.

"Infra-Red Spectrography by Reflection: Application to Polymers," J. Henniker, IND. PLASTIQUES MOD., 12, 6, 30 (July 1960).

The difficulty of obtaining the extremely thin samples needed for the usual spectrometry method by transmission is avoided by using reflection spectrometry which requires only a very small, level polished area. Comparative results obtained on polystyrene, phenoplastics, and polyurethanes by the two methods are shown. (In French.)

"St. Gobain Mass Polymerization of Vinyl Chloride," Leo Walter, RUBBER & PLASTICS AGE, 41, 6, 665 (June 1960).

How the St. Gobain plant compounds and polymerizes PVC.

Equipment

"Blow Molding—An Equipment Directory," W. O. Bracken, SPE J., 16, 6, 625 (June 1960).

A listing of machines and their specifications.

"Winders and Winding," R. Frenz and K. Fischer, KUNSTSTOFFE, 49, 10, 583 (Oct. 1959).

The requirements of wind-up equipment are dealt with. The various types of haul-off and winding devices on the market are classified and differences discussed. (In German.)

"Comparison of Plunger and Screw Cylinders of Injection Molding Machines," H. Goller, KUNSTSTOFFE, 49, 10, 531 (Oct. 1959).

The two types of cylinder are compared on the basis of theoretical investigations and practical tests and trial runs, purely from the standpoint of elementary physical laws and the functions of the two types of cylinder. (In German.)

"Model Plant for Continuous Production of Ziegler Polyethylene," S. Sommer, S. Wagener, and H. Ebner, KUNSTSTOFFE, 49, 10, 500 (Oct. 1959).

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Polypropylene	Very Good
Polystyrene	Very Good
Nylon	Very Good

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Description of the construction and operation of the model plant for continuous production of low-pressure Ziegler polyethylene, first demonstrated at the Brussels World Fair, 1958, and again at the 1959 Dusseldorf Plastics Exhibition. (In German.)

"Rolling Ball Viscometer for Technical Application," J. G. Robinson, BRIT. PLASTICS, 33, 5, 209 (May 1960).

Details are given of the apparatus and experimental technique used in a rolling-ball method for measuring viscosity which though not to be classed as a precision method, is yet sufficiently accurate for most technical applications.

"High Frequency Heating," V. Bird, PRACTICAL PLASTICS, 2, 7, 29 (July 1960).

A discussion of high-frequency heating for inductive and capacitive heating.

"A Guide to Winding—Part 2," S. F. Oakes and A. A. Arterton, MODERN PLASTICS, 38, 1, 124 (Sept. 1960).

A discussion of the auxiliary equipment required to do a proper winding job, with typical case histories on machinery and cost estimates.

"Vacuum Forming Molds," H. Werrell, PLASTICS (LONDON), 25, 273, 271 (July 1960).

The first of a series of three articles that discusses the uses, merits, and possible future developments in epoxide resins for tool making. The articles express only the viewpoints of three groups; the resin formulator, the tool maker, and the resin manufacturer.

"Injection Mold with Automatic Central Gate Cutter," H. Gastrow, KUNSTSTOFFE, 50, 5, 315 (May 1960).

In the mold described, the central gate is automatically cut off when the mold is opened. (In German.)

Applications

"Bow and Arrow, a Modern Sports Application using Glass Fiber Reinforced Resin," W. Beyer, KUNSTSTOFFE, 50, 8, 474 (Aug. 1960).

The popularity of the bow and arrow depends on their weight and strength. It has been found that bows and arrows made of glass fiber-reinforced resin, both with and without the additional use of wood, fulfill the demands.

"Polyurethane-Based Adhesives for Metals," K. Schwaner, PLASTE U. KAUTSCHUK, 7, 2, 59 (Feb. 1960).

In bonding aluminum with a reaction product of Desmodur TH and a polyester containing hydroxyl groups, polyesters with a low OH number yielded high tensile shear values. These values are influenced by the amount of Desmodur TH and curing temperatures. The bonds resisted benzene, but not water or other solvents. (In German).

"Plastisols Coming Into Their Own as Economical Protective Coatings," James Guffie, CANAD. PLASTICS, p. 40 (July 1960).

A short review of the wide range of applications for plastisols.

"Connections for Ziegler Polyethylene Pipes," K. Richard, E. Gaube, and D. Diedrich, KUNSTSTOFFE, 50, 6, 325 (June 1960).

The authors have investigated many joining methods for lengths of Ziegler pipe, as well as flanges and fittings. The authors' method utilizes procedures that simulate actual conditions. Test results are given.

"Medium-Density Polythene and Packaging," C. S. Imig and J. F. Morris, APPLIED PLASTICS, 3, 7, 36 (July 1960).

Test data indicate that performance of these resins is superior to that given by the low-density resins.

"Screw Plastification in Injection Molding," Jack Monster, CANAD. PLASTICS, p. 50 (June 1960).

Details of the screw design.

"Compatability of Magnet Wire Insulations and Epoxy Encapsulating Resins," H. Lee, ASTM BULL., No. 247, PP. 69 (July 1960).

The compatability ratings of amine and acid-catalyzed epoxy resin encapsulating systems with 10 commercial magnet wires are given, together with the test method used to determine these ratings.

"Third Conference on Plastics in Agriculture," IND. PLASTIQUES MOD., 12, 3, 13 (April 1960).

Ten short papers cover such topics as irrigation, packaging, and greenhouses. (In French).

"Prospects for Plastics in Packaging Fruits and Vegetables," M. Parducci, MATERIE PLASTICHE, 26, 5, 406, (May 1960).

The various existing methods for packaging vegetables and fruits for transportation, storage, and retail selling are dealt with. The possibilities of extending the present limited use in Italy of plastics for some of the applications are examined. (In Italian.)

"Fittings and Partitions of Plastics Materials," P. Catalano, POLIPLASTI, 8, 39, 28 (March-April, 1960).

The author discusses the present extent and possibilities of the use of plastics in Italy for windows, doors, louvers, shutters, panels and partitions, and at the same time points out advantages and problems connected with these applications. (In Italian.)

"Glass-Reinforced Plastics in Automobile Construction," W. Beyer, KUNSTSTOFFE, 50, 5, 284 (May, 1960).

The prospects of glass-reinforced polyester resins for automobile bodies are considered. A comparison of the properties of these materials with those of deep-drawn steel reveals how inadequate is the knowledge on long-term behavior, testing and evaluation of the former. Available information on the subject is critically examined and new proposals offered. Finnish and surface problems will be treated in a future article. (In German.)

"The Present Position of the Application of Polyvinyl Acetate," R. J. Schoonbeek, PLASTICA, 13, 2, 110 (Feb. 1960).

Applications of PVA in decorative, flame resistant paints; coatings for metal components; and adhesive and bonding agents. (In Dutch).

"New Plastic Materials for Packaging," B. H. Coulls, PRACTICAL PLASTICS, 2, 7, 17 (July 1960).

A discussion of the four categories into which plastics fall: flexible packaging; laminated flexible packaging; rigid sheet and foil; and blow-molded containers.

"Plastics in Shipbuilding," PLASTICS, 25, 269, 91 (March 1960).

A series of articles on applications of plastics in shipbuilding. Some topics include the future of plastics in shipping; plastics in lighthouse service, lifesaving equipment, plumbing, and insulation; nylon propellors; and materials and applications for the *Canberra*.

"Rigid PVC Sheet Bonded to Wood for the Furniture Industry." C. Kubitsky, KUNSTSTOFF-RUNDSCHAU, 7, 2, 86 (Feb. 1960). Details on types of wooden supports, adhesives, and methods of bonding PVC-surfaced wood. (In German).

"Conference on 'The Influence of Plastics in Building,'" TRANS. PLASTIC INST., 28, 73 (Feb. 1960).

Devoted to plastics in building. Topics include operations, construction, dome and roof structures, services, thermal insulation, and performance and esthetics.

"Large Constructional Plastics Elements for House Building," R. Doernach, KUNSTSTOFFE, 50, 6, 355 (June 1960).

For economic reasons, it is necessary to produce prefabricated constructional elements or houses in quantities of 20,000 per annum. The special properties of plastics enable self-supporting shells to be produced.

"Italian Plastics Holiday House," A. Schwabe, KUNSTSTOFFE, 50, 6, 353 (June 1960).

A house in which plastics have been employed sensibly is described. Plastics in the house are used mainly in the walls and the ceiling elements.

"Greater Military Use of Plastics," W. E. Victor, CANADIAN PLASTICS, p. 28 (Aug. 1960).

A brief review of current plastics applications for the military.

General

"Practical Experience in the Netherlands with Plastic Pipe," F. W. R. Wybrans, PLASTICA, 13, 2, 90 and 13, 3, 191 (Feb. and March 1960).

Review of experiences with PVC pipe for gas and water and polyethylene pipe for water. (In Dutch).

"The Impact of Petrochemical Development on the Plastics Industry," H. M. Stanley, TRANS. PLASTICS INST. 28, 75, 110 (June 1960).

A review paper on developments in the petrochemical field that affect plastics.

"Bulk Handling of Carbon Black," A. E. Williams, RUBBER & PLASTICS AGE, 41, 7, 813 (July 1960).

A discussion of the Tote system for bulk handling of carbon black.

"Window on Russian Research," M. Gordon, PLASTICS (LONDON), 25, 274, 315 (Aug. 1960).

A brief report on papers presented at the International Symposium on Macromolecular Chemistry that was held in Moscow in June.

"Plastics Packaging Materials and Machines at the 1960 Interpack," H. Behringer and E. Escales, KUNSTSTOFFE, 50, 8, 447 (Aug. 1960).

A systematic picture of the many plastics packaging materials and machines seen at the last Interpack exhibition.

CALENDAR of COMING EVENTS

November 18
SPE Newark Section RETEC. Blow Molding Comes of Age. Hotel Essex House, Newark, N. J.

November 22
Manufacturing Chemists' Association, Tenth Semi-Annual Meeting and Midyear Conference. Statler-Hilton Hotel, New York, N. Y.

November 27-December 2
ASME Winter Annual Meeting. Statler-Hilton Hotel, New York, N. Y.

November 30-December 2
U. S. Army Signal Research and Development Laboratory. Ninth Annual Symposium on Technical Progress in Communication Wires and Cables. Berkeley-Carteret Hotel, Asbury Park, N. J.

November 30-December 2
British Plastics Federation. International Reinforced Plastics Conference. Cafe Royal, London, England.

January 24-27
SPE Seventeenth ANTEC. Shoreham Hotel, Washington, D. C.

February 7-9
SPI Sixteenth Reinforced Plastics Division Conference. Edgewater Beach Hotel, Chicago, Ill.

February 26-March 1
American Institute of Chemical Engineers. Petrochemical and Refining Exposition. Municipal Auditorium, New Orleans, La.

March 21-30
American Chemical Society. 138th National Meeting. St. Louis, Mo.

April 20-21
SPI Eighteenth Annual Western Section Conference. Hotel del Coronado, Coronado, Calif.

June 5-9
SPI National Plastics Conference. Commodore Hotel, New York, N. Y.

June 5-9
SPI Ninth National Plastics Exposition. Coliseum, New York, N. Y.

June 16-25
Europlastica International Plastics Exhibition. Palais des Floralies, Ghent, Belgium.

"Transparent Coloring of Methyl Methacrylate with Dyes Sensitive to the Oxidizing Action of Benzoyl Peroxide Catalysts," G. M. Reiner, MATERIE PLASTICHE, 26, 5, 399 (May 1960).

The method is described for producing satisfactory transparent blue, green and violet polymethacrylate with coloring materials sensitive to oxidation by benzoyl peroxide catalysts by the addition of tertiary amines, like diethanol aniline, p-methyl-dimethyl aniline, and especially dimethyl aniline. Tests are also in progress on tetramethyl benzinine and tetramethyl-o-dianisidine, both of which are efficient polymerization accelerators used in combination with benzoyl peroxide. (In Italian.)

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Domestic Production and Sales of Plastics and Resin Material, June and July, 1960

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of June and July, 1960. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

	June, 1960		July, 1960	
	Production	Sales	Production	Sales
Cellulose Plastics:				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,771,799	1,851,411	1,346,062	1,334,784
Sheets, 0.003 gage and over	2,079,830	1,836,505	1,849,727	1,454,059
All other sheets, rods, and tubes (including other cellulose plastics)	790,871	896,530	585,692	581,644
Molding and extrusion materials (including other cellulose plastics)	8,054,864	8,068,194	6,854,377	8,068,194
Nitrocellulose sheets, rods, and tubes	—	118,539	—	94,958
TOTAL	12,637,365	12,771,179	10,635,858	11,533,639
Phenolic and Other Tar-Acid Resins:				
Molding materials	19,338,838	15,550,523	12,067,621	11,425,798
Bonding and adhesive resins for—				
Laminating (except plywood)	5,364,225	3,355,780	4,424,945	3,084,346
Coated and bonded abrasives	1,179,599	921,691	636,470	621,898
Friction materials (brake linings, clutch facings, and similar materials)	947,211	837,829	665,633	877,470
Thermal insulation (fiber glass, rock wool)	3,497,550	3,299,115	3,113,548	2,880,117
Plywood	4,086,043	3,259,616	3,341,212	2,900,941
All other bonding and adhesive uses	5,768,723	5,200,226	4,396,849	4,462,595
Protective-coating resins unmodified and modified except by rosin	2,010,432	1,859,803	1,786,853	1,880,711
Resins for all other uses	3,570,269	3,233,450	2,460,305	2,345,165
TOTAL	45,762,890	35,518,033	32,893,436	30,479,041
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	2,900,471	2,415,451	1,698,048	1,898,251
Paper-treating and paper-coating resins	2,866,150	2,363,014	1,570,786	1,904,929
Bonding and adhesive resins for—				
Laminating	3,149,620	2,132,518	1,978,542	2,071,504
Plywood	7,272,186	6,804,446	5,932,711	6,151,789
All other bonding and adhesive uses	2,496,722	2,386,558	1,933,315	1,763,547
Protective-coating resins, straight and modified	3,312,756	2,372,119	2,902,343	1,878,328
Resins for all other uses, including molding	9,839,415	8,003,245	5,012,517	6,709,994
TOTAL	31,747,322	26,506,351	21,028,262	22,378,342
Styrene Resins:				
Molding and extrusion materials:				
Straight polystyrene	24,141,283	18,077,626	23,168,439	15,445,781
All other	29,844,686	25,866,258	29,712,591	20,916,746
Protective-coatings	6,024,096	5,128,502	4,932,454	4,295,751
Textile and paper treating and coating resins	5,133,911	4,949,411	4,978,772	3,910,587
All other uses	15,287,245	19,544,196	14,448,367	19,250,307
TOTAL	80,433,221	73,565,993	77,240,623	63,919,172
Vinyl and Vinyl Chloride Resins:				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		9,035,561		5,860,613
Sheeting (resin content)		12,073,818		9,804,638
Molding and extrusion (resin content)		23,683,258		18,414,102
Flooring (resin content)		5,331,549		3,956,183
Protective coating (resin content)		12,488,646		10,106,743
All other uses (resin content)		3,846,035		3,484,750
All other vinyl resins for—				
Adhesives (resin content)		11,534,426		9,155,188
Protective coatings (resin content)		5,265,352		4,115,791
All other uses (resin content)		2,433,047		2,467,843
		9,278,456		9,304,949
TOTAL	93,687,738	94,970,149	83,735,133	76,670,800
Coumarone-Indene and Petroleum Polymer Resins	21,040,681	20,777,821	17,239,089	17,076,865
Polyester Resins:				
For reinforced plastics	11,696,251	10,703,404	8,738,678	8,685,417
For all other uses	2,164,982	2,155,699	1,492,895	1,428,668
TOTAL	13,861,233	12,859,103	10,231,573	10,114,085
Polyethylene Resins:				
For film and sheeting		30,621,990		31,433,272
Molding materials		12,638,692		11,200,235
Extrusion materials		14,344,420		10,118,866
For all other uses		39,473,223		41,748,858
TOTAL	102,263,535	97,078,325	103,695,304[1]	94,501,231[2]
Epoxy Resins:				
For protective coatings		2,180,755		1,585,296
For all other uses		2,851,675		2,557,056
TOTAL	5,398,270	5,032,430	4,879,808	4,142,352
Silicone Resins	4,329,208	366,944	440,505	384,728
Miscellaneous Synthetic Plastics and Resin Materials	25,476,690	22,727,739	21,057,138	19,448,842
GRAND TOTALS	432,748,152	402,174,067	383,076,729	350,649,097

[1]17.1% produced by the low-pressure process.
[2]12.9% produced by the low pressure process.
SOURCE: United States Tariff Commission, Chemical Division.

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